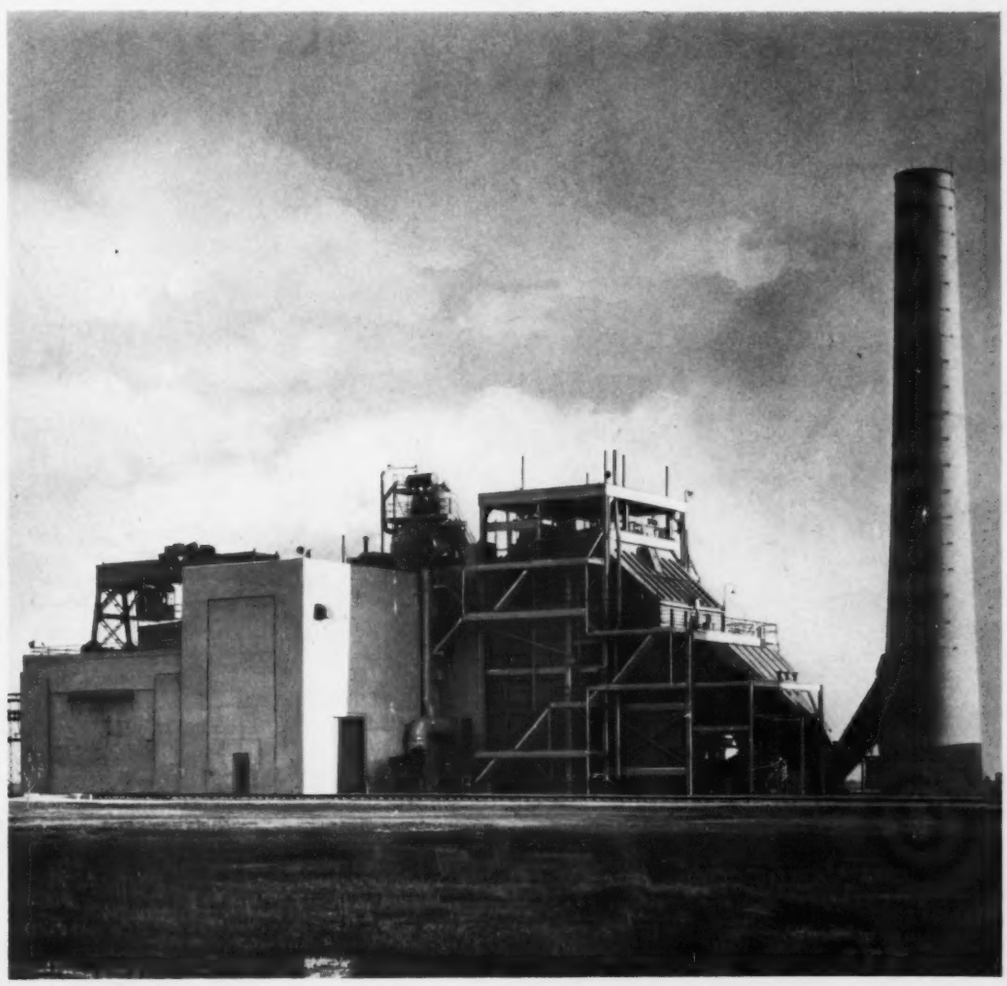
GIN-ERG
LIB

Electrical World



MAY 11, 1946

Basis for Interconnection Reserves • Semi-Outdoor Plant Saves 10 Percent

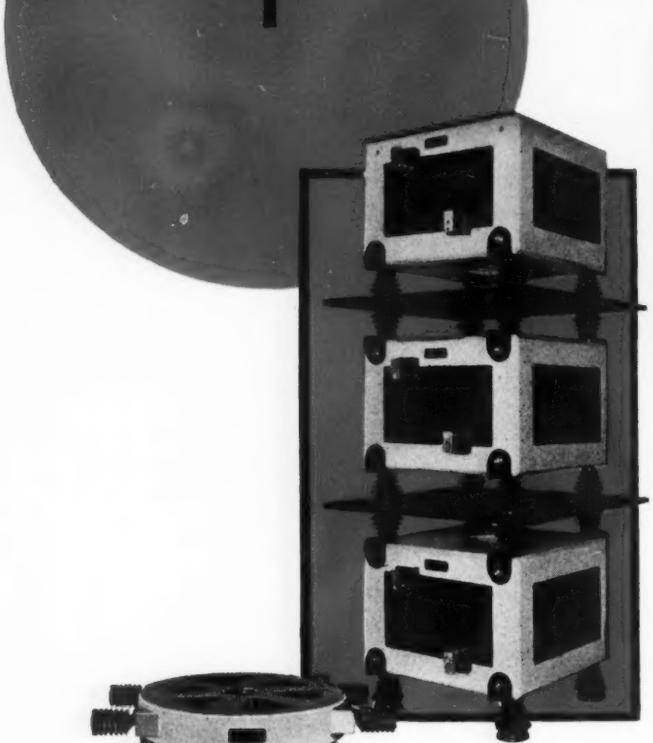
Transformer Capabilities Unrealized Because of Fuses • Substations Can Be Simplified

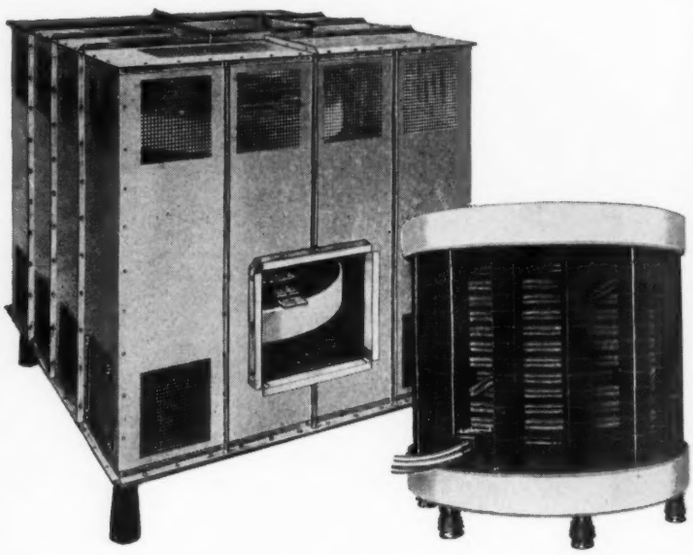
Pushbutton Wiring System • Cable Innovations in Europe

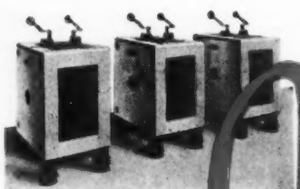
A McGRAW-HILL PUBLICATION

Lessen the THREAT of

power-flow INTERRUPTIONS!







THE ability of Murray Current Limiting Reactors to withstand severe short circuit conditions is a matter of record—since the first one was built in 1910. Their reliability and sturdiness have been proved—unquestionably.

Murray Reactors are "hand-tailored" to meet definite characteristics of the particular system. And if available space for their installation is limited as in crowded plants, their size is determined to suit the conditions.

Service records of Murray Low Loss Reactors disclose the clearing of the most severe short circuits, with the resultant saving of thousands of dollars in plant equipment, maintenance and operation.

Be prepared with Murray Reactors—their installations pays and pays well.

Metropolitan Device Corporation, Brooklyn, N. Y.

OTHER MURRAY DEVICES

Aerial Ladder
Cable Racks
Malleable Strapping
Meter Boxes
Meter Seals
Meter Switches
Panelboxes
Safety Switches
Testing Devices
Wiring Troughs

HIGHEST
All-Year Efficiencies

HIGHEST
Short Circuit Protection

LOWEST
Temperature Rises

Murray

—the foremost name on current-limiting

REACTORS

Electrical World

FOUNDED IN 1874 • READ BY ELECTRICAL MEN FOR 72 YEARS

SAMUEL B. WILLIAMS.....*Editor*

ARCHER E. KNOWLTON..*Associate Editor*
FRANK R. INNES.....*Associate Editor*
RUE M. SHOOP.....*Assistant Editor*
JULIUS C. MEIER...*Manufacturing Editor*
DANIEL J. KILKELLY....*Industrial Editor*
KENNETH K. KOST.....*News Editor*
EDNA M. GLENNON.*Assistant News Editor*
DANIEL T. BRAYMER.....*Western Editor*
FRANK E. SANFORD
Associate Western Editor
HOWARD S. KNOWLTON
New England Editor
WALTER C. HESTON..*Pacific Coast Editor*
RICHARD N. LARKIN
Washington Correspondent
DONALD D. HOGATE
Manager, Washington Bureau
STACY MAY.....*Director, Economics Staff*

M. S. MacNAUGHT.....*Manager*

DISTRICT MANAGERS
E. F. COFFEY.....*New York*
N. V. PALMER.....*Boston*
F. P. COYLE.....*Philadelphia*
C. R. LIPPOLD.....*Cleveland*
S. H. BABCOCK.....*Detroit*
W. H. MENEILLEY.....*Chicago*
J. T. SCHAEFER.....*St. Louis*

LEE H. HILL.....*Publisher*

The contents of this issue are copyrighted and may not be reproduced without the permission of the copyright owners.

May 11, 1946

Contents

Vol. 125, No. 19

Novel Trends in European Cable Design..... 76
OTTO JENSEN, I-T-E Circuit Breaker Co.

Reserve Requirements for Interconnected System..... 78
H. W. PHILLIPS, Pennsylvania-New Jersey Interconnection

Minimum Housing Employed for Low-Cost Houston Plant... 82
R. E. HANSEN and LOUIS ELLIOTT, Ebasco Services Inc.

Now's the Time to Sell Street Lighting..... 85
HENRY G. CLUM, Art Metal Co.

Simplicity of Substations Rests on Voltage Stratification..... 87
P. D. TUTTLE, Hydro-Electric Commission of Quebec

Pushbutton Wiring System for Post-War Homes..... 90

Fuses Fall Short of Transformer Capabilities..... 92
L. L. STAHLER, Florida Power & Light Co.

Quick-Trip Bus Ties Reduce Breaker Duties..... 95

Digests 96

Editorials .....75 and 100

Washington Comment..... 102

News of the Week..... 103

HOW 111

Engineering Reference Sheets.....120, 124 and 126

THE COVER — Houston extension confirms successful results after two years' operation of semi-outdoor design which saves approximately one-tenth of outlay.

Load Building 136

New Equipment 140

Catalogs and Bulletins..... 151

News About People..... 163

Manufacturing and Markets..... 174

Sales Opportunities 180

Rural Allotments 182

Recent Rate Changes..... 183

Recent Legislation 185

Index of Advertisements..... 190

ELECTRICAL WORLD

Published weekly. Price 25 cents a copy. Publication office 99-129 N. Broadway, Albany 1, N. Y. Allow at least ten days for change of address. Address communications about subscriptions to J. E. Blackburn, Jr., Vice-President for Circulation Operations.

RETURN POSTAGE GUARANTEED

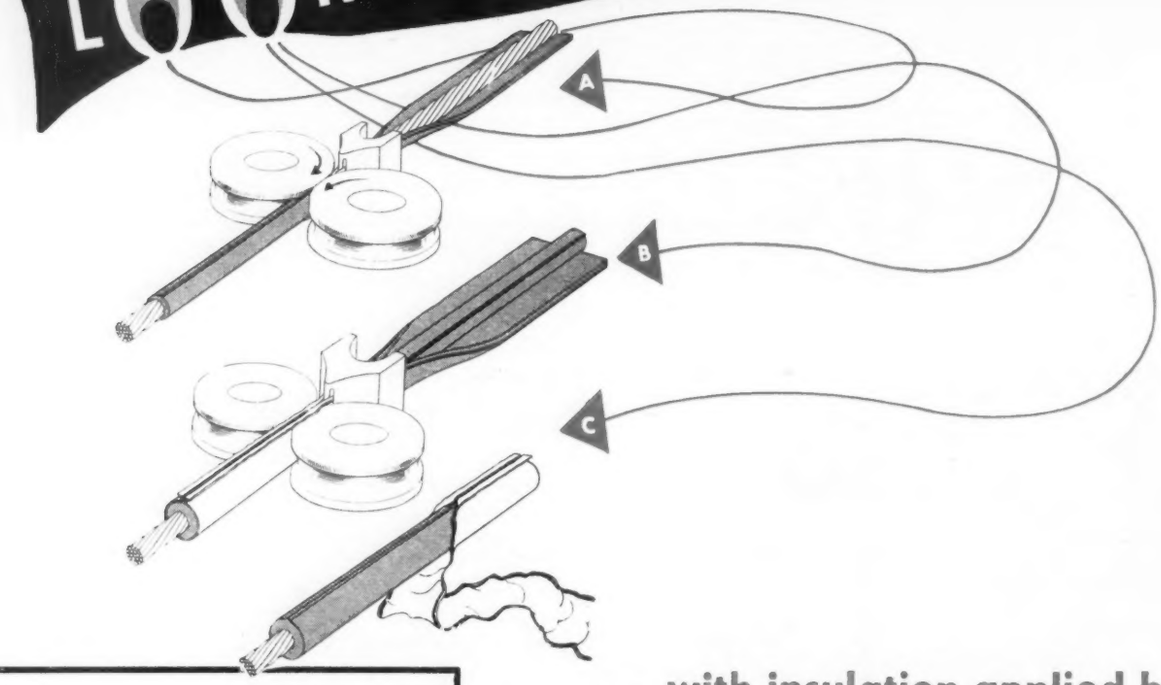
Subscription rates: In the United States, $5 a year, $8 for two years, $10 for three years. Canada $6 for one year, $10 for two years, $12 for three years (Canadian money at par). Pan-American countries $15 for one year, $25 for two years, $30 for three years. All other countries $20 for one year, $30 for two years, $40 for three years. Please indicate position and company connection on all subscription orders. Entered as second class matter November 16, 1936, at Post Office at Albany, N. Y., under the Act of March 3, 1879.
Printed in the U.S.A. Contents copyrighted, 1946, by McGraw-Hill Publishing Company, Inc. All Rights Reserved.
Branch Offices: 520 North Michigan Avenue, Chicago 11, Ill.; 68 Post Street, San Francisco 4; Aldwych House, Aldwych, London, W.C.2; Atlanta, Ga.; Boston, Cleveland, Detroit, Los Angeles, Philadelphia, Pittsburgh, St. Louis, Washington.

McGRAW-HILL PUBLISHING CO., INC.
JAMES H. McGRAW
Founder and Honorary Chairman

Publication Office .....99-129 N. Broadway, Albany 1, N. Y.
Editorial and Executive Offices....330 West 42nd St., New York 18, N. Y.
JAMES H. McGRAW, JR.....President
CURTIS W. McGRAW.....Senior Vice-President and Treasurer
HOWARD EHRLICH.....Vice-President and General Business Manager
EUGENE DUFFIELD.....Editorial Assistant to the President
JOSEPH A. GERARDI.....Secretary
J. E. BLACKBURN, JR.....Vice-President (for Circulation Operations)

Member A.B.P. Member A.B.C.
Cable Address McGRAW-HILL, New York

LOOK FOR LONGER CABLE LIFE



Only Cables Insulated with

OKONITE

Give You All 5

1. Conductors better protected from corrosion by an Okoloy coating over the copper.
2. Long-lived insulation, made with wild Up-River Fine Para rubber, carefully washed and dried.
3. Foot-by-foot inspection of the insulation strips before and during their application to the wire.
4. Perfect centering of conductors by the Okonite strip insulating process.
5. Greater density, uniformity and higher electrical values through vulcanization in a continuous metal mold.

. . . with insulation applied by the Okonite strip process

Okonite's unique and widely-known strip insulating process gives wire and cable the physical properties and performance characteristics that mean longer and more effective life.

Inner strips of insulation are applied to conductors in the manner shown in Sketch A. The final layer is backed by tin (Sketch B) which forms a continuous metal mold. After vulcanization and the peeling off of the tin (Sketch C) every foot of Okonite has been simultaneously vulcanized at the same temperature and pressure.

. . . and insulation made with wild Up-River Fine Para rubber

This rubber is available for restricted applications . . . for those severe service conditions where wires and cables are to be installed in wet locations. Wild Up-River Fine Para is the only rubber ever used in Okonite insulation. Authorities pronounce it preferable to plantation rubber from the standpoints of uniformity, better aging and superior performance — and nearly 70 years of field experience have shown this to be a fact.

Bulletin 101 gives you further information on the rubber used in Okonite insulation and the famous Okonite method of applying it. Write for a copy. The Okonite Company, Passaic, N. J.

OKONITE OKONITE SINCE 1878 **insulated wires and cables**

4479

Electrical World

MAY 11, 1946

Who Shall Be the Servant?

ONCE MORE a group of industry people have put their personal affairs to one side in order to help the government meet an emergency. Working under the direction of the former head of the Office of War Utilities, this group of men will advise the Civilian Production Administration how to help the utilities maintain operation during the period of the coal strike.

While most of the coal-burning electric utilities have sufficient fuel on hand to carry them through this month, a number of companies have already felt the pinch and have had to apply to their state commissions for relief of some sort. This condition can be expected to spread as the strike continues.

Because the situation is still so local and also because such a large part of the country depends largely on water, oil or gas for electricity generation, it is likely that any regulations affecting energy use will remain with the states and municipalities, for the present at least. Nevertheless, Washington is keeping closely in touch with the situation. Through this CPA utility group of men who have been through fuel conservation before and know how to handle it, the industry and the government are assured that only such measures will be taken as are necessary and only in the areas where they are needed. In other words, there will be the maximum public protection with the minimum interference and confusion.

While CPA and the Solid Fuels Administration are to be commended for taking such steps as will be necessary to maintain essential utility service, it seems to us that a brownout or any other expedient to limit the use of electricity is not the answer to the fuel supply problem. Why should the government use its war powers to restrict the activities of people going about their own business before first trying out these powers on those responsible for the fuel situation? If the war powers are ineffective with them, why should they be effective with others?

During the war miners were working and consumption was in excess of production. Conservation was necessary and was made mandatory. Today the miners are not working; if they were, there would be no fuel difficulty.

Isn't that the place to begin to protect the public interest? Why should the public be denied the right to work, to ride or be entertained as it desires, in order to safeguard the rights of a much smaller segment of society which has been the aggressor?

Utilities do not like brownouts, but they like less the idea of asking customers voluntarily to curtail their use of service. If there has to be any restriction, let it be by law and be enforced uniformly by those having police power and then only when and where needed.

Before that happens on a national scale, however, maybe the government will forget politics long enough to screw up its courage and find out once and for all whether it or the coal industry and its workers is the stronger. Shall coal be the servant of the people, or the people the servant of coal? With the issue now squarely before us, this would be a good time to find out.

Novel Trends in European Cable

T.I.I.C. representative's survey reveals high-voltage buried cable design, aluminum for sheathing, continuous press, drawn polyvinyl-chloride insulated cable and flat synthetic house wiring cable

AMONG THE DEPARTURES in cable practice in Europe noted in connection with assignment as member of the Technical Industrial Intelligence Committee were the following of likely interest to American power engineers:

A flat design of buried high-voltage sheathing.

Use of aluminum for cable sheathing.

Drawn polyvinyl-chloride insulated cable.

Cables made longitudinally watertight.

Cheap form of flat house wiring.

The details of these developments are adapted from the author's "Report on Recent Cable Development in Germany" which is Field Information Agency, Technical Final Report No. 516 of November 16, 1945, to the Office of Military Government for Germany (U. S.).

Flat Cable

In a high-voltage lead-covered cable developed and installed in Denmark the three conductors are placed side by side in a flat arrangement and a lead sheet is extruded around this conductor arrangement, with the longitudinal seam of the lead sheet in the center of the narrow side of the cable. The flat sides of the cable are reinforced by means of two corrugated bronze strips held in place by means of a bronze wire tightly spiraled around the cable.

This cable is buried in the ground without the use of conduits. It is filled with oil in the usual manner but does not require any oil reservoirs. Temperature change in the cable during operation and the corresponding oil expansion and contraction merely caused the flat side of the lead sheet to give. The reinforcing bronze strips prevent permanent deformation of the lead and the bronze wire maintains a fixed compression force on the cable. The oil therefore does not have to travel longitudinally through the cable in order to find space for its expansion. Higher oil pressure can be used with consequent reduction of insulation. A 2½-km. length of 66-kv. cable installed at Aarhus Electric Co. in 1941 has been operated satisfactorily ever since.

Aluminum Sheath

Aluminum covering of power cables has become a standard practice in Germany where the scarcity of lead was responsible for the development of aluminum-covered cables. Many difficulties were experienced before the cable could be produced and a special hydraulic press had to be installed before large scale production was possible. The use of aluminum covering effects a great weight saving; for example, a single conductor, aluminum-covered, oil-filled, 125,000-volt cable weighs 8.89 tons per mile against 16.8 tons per mile, making a weight saving of 47 percent. The corresponding weight saving of a four-pair telephone cable is 67 percent and of a 166-pair telephone cable, 49 percent. The outside diameter of the cables is somewhat smaller than corresponding lead cable and it is possible to transport and install longer lengths of cable due to the lighter weight which in turn reduces the number of cable splices.

Cable terminal and splices have been worked out satisfactorily (Fig. 2). The aluminum cable sheet and the splicing sleeve, or end bell, is first tinned with a special solder after which the cable joints are wiped in the usual manner.

In a proposed cable sheathing press arranged for continuous operation, the aluminum is forced into the press under pressure and a double conveyor worm forces the plastic aluminum through cable extrusion die (Fig. 4).

Polyvinyl-Chloride Cable

A considerable amount of experimentation has been conducted on a new process of producing cables. Due to the termination of the war the process was never adopted commercially but sufficient experiments have been made to prove the process feasible.

The starting point is a billet consisting of an outer tube approximately 2 in. in diameter and with a core thickness of $\frac{1}{16}$ in. In this tube is inserted a number of rods corresponding to the number of conductors in the cable. The tube is then filled with a powder known as polyvinyl chloride (trade name, Igelit) made by I. G. Farben. The billet is drawn through a standard draw die causing compression of the Igelit powder. A centering device which is inserted internally in the cable and mechanically held a short distance ahead of the draw die assures equal distribution of the powder. Further reduction in diameter is made through successive draw operations and the cable can be drawn to an outside diameter of less than $\frac{1}{16}$ of an inch if so desirable without annealing between operations. The cable stays flexible and can stand several severe bendings. After the final diameter of the cable is reached, the cable is reeled and immersed in an oil bath of 180 deg. C. The heating of the cable transfers the Igelit powder into a homogeneous insulating mandel. This process can be used with either aluminum or copper and has been tried with copper conductors and steel mandel.

This cable seems to be particularly applicable to household wiring where the metal sheathing could be used as the return conductor.

House Wiring

A cheap house-wiring cable consists of conductor arranged in flat arrangement and insulated by synthetic rubber compound, with the conductors spaced far enough apart to permit the cable to be nailed directly to the plaster support. The cables are encased in the plaster and special fittings with plug-in switches and outlets are provided. This cable is cheap to produce and cheap to install and adoption of this system in the United States should tend to

Design

OTTO JENSEN,
I-T-E Circuit Breaker Co.
Philadelphia

cheapen the installation as well as encourage the use of more outlets in new household construction.

Siemens-Schuckert also produced cables which were water tight lengthwise for the German Navy. This development was brought about by the necessity for preventing flooding of undamaged ship compartments through damaged cables.

Experiments have also been made in a unique way of making telephone cable water tight. A standard multiconductor paper-insulated telephone cable is encased in an aluminum sheeting consisting of two strips of 0.025-in. aluminum. The two strips are placed lengthwise and shaped to fit the contour of the cable. The strips are sufficiently wide to form two longitudinal fins, one on each side of the cable. The two strips on each fin are welded together lengthwise without application of heat, solder, flux or other means, except pressure. The rolls press the strips together and form three close-spaced welds in each fin. It is impossible to tear the welds apart and they appear as a homogeneous mass when viewed through a microscope. The two fins are then bent to lie close to the cable which is processed with jute and armor for underground use or a messenger wire is wrapped around the cable to permit aerial installation without the use of the messenger clamps. This construction produces an extremely lightweight cable.

FIG. 1—No oil reservoirs needed with this flat arrangement of buried high-voltage cable

FIG. 2—Aluminum sheath and splicing sleeve first tinned with special solder before conventional wiping

FIG. 3—Special horizontal press for applying aluminum sheath to power cable

FIG. 4—Proposed press for continuous application of aluminum sheath. Double conveyor worm forces plastic metal through the cable extrusion die

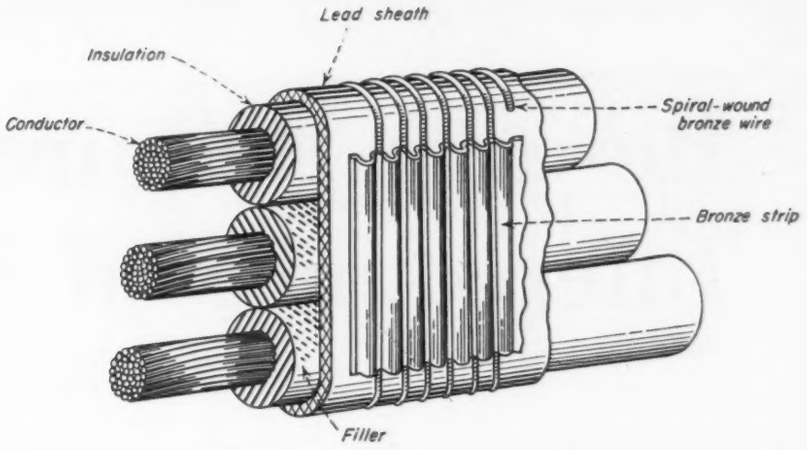


FIG. 1

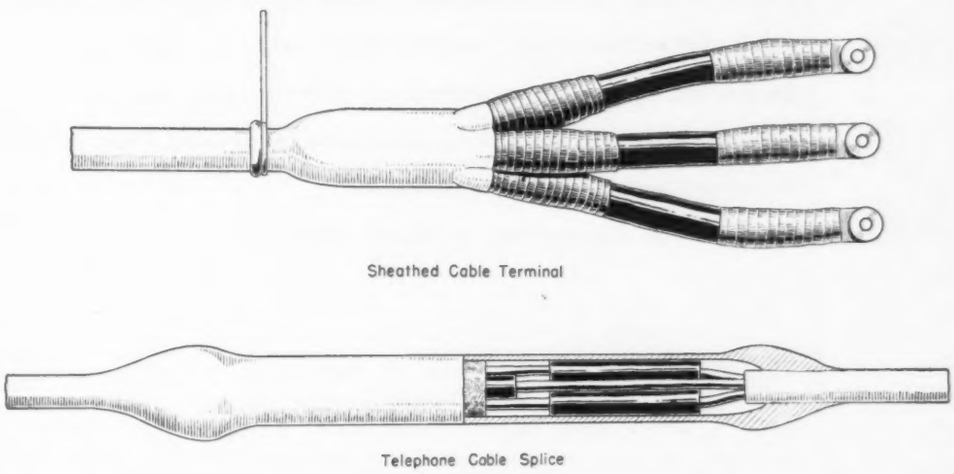


FIG. 2

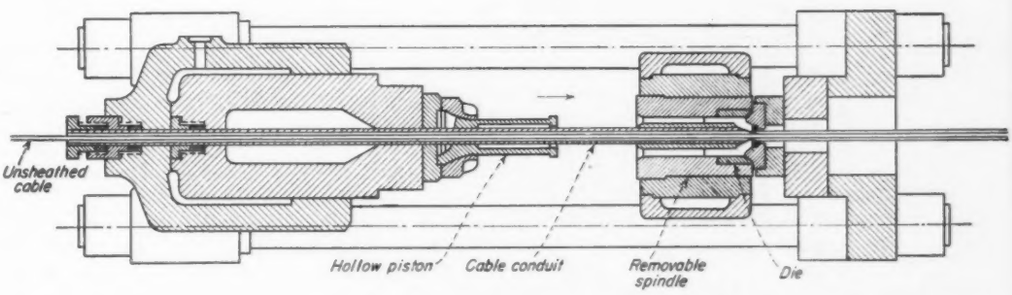


FIG. 3

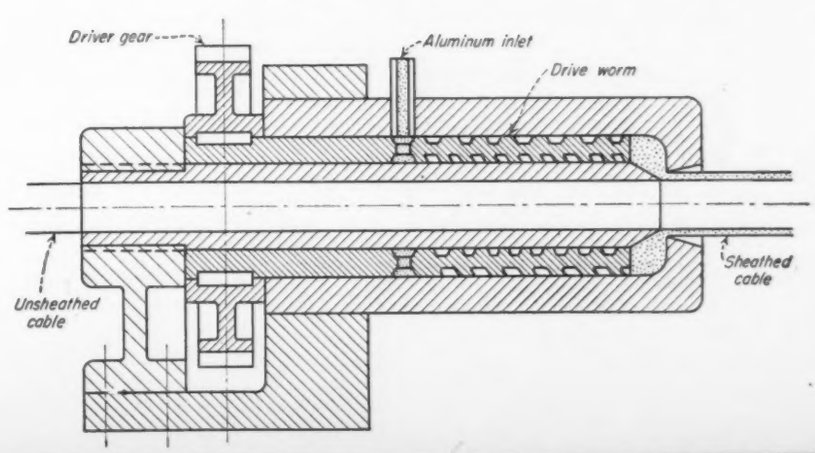


FIG. 4

Reserve Requirements for Interconnected System*

H. W. PHILLIPS, *Supervisor, Pennsylvania-New Jersey Interconnection*

Load estimate deviations deserve recognition along with allowance for boiler and turbine failures in fixing spinning reserve—Cold reserve based on longer-term factors—Maintenance alone may demand provision of reserves because of flattening of load curves

THAT THERE ARE many kinds of reserve is due primarily to the differences in time element taken in each particular case; the reserve required in any element of time varies with the quantity and type of equipment involved, as well as certain other factors. The spinning reserve requirement at the time of the daily peak involves the shortest time element, and for that reason constitutes a good point of departure.

Spinning reserve is required at the time of the daily peak to protect against:—

1. Failure of turbines.
2. Failure of boilers.
3. Load estimating errors.
4. Transmission failure (in some cases).

"Largest Unit" Practice

Protection of the system against the loss of the largest unit was for many years a standard practice of numerous companies; however, some larger companies with relatively small units carried reserve equivalent to two or more units. During the same period, when the majority of companies were isolated, boilers were small in comparison to turbines and the existence of extra boilers made it unnecessary to protect the system against boiler failure. Furthermore, the largest turbine was frequently more than 10 percent of the system load and protection against its failure automatically gave protection against normal load forecasting errors.

As a result of interconnection (and load growth) the largest units have become increasingly small in comparison to the combined interconnected load, and consequently, protection against the loss of such a unit does not necessarily mean protection against load forecasting errors, which may constitute a greater hazard.

During the same period that the larger interconnections were being established, improvements in the art of electrical generation created a revolutionary trend in boiler design, which resulted in boilers that were equal in capacity to one-half, and in some cases the full rating, of the turbines which they serve. Under these conditions, the boiler failure hazard will generally exceed that of the turbine hazard.

Forecast Errors

After considering these various changes in the characteristics of the electric system it became evident that boiler failures and load forecasting errors, as well as turbine failures, must be considered in determining the reserve requirements of any system.

Time, as affecting the type of reserve, can mean that it is used in the sense of measure of duration or measure of frequency. Statistics accumulated over a period of several years will provide the information that is necessary for determining the frequency of turbine and boiler failures, while data collected over a year or two will give ample information as to the frequency and magnitude of load forecasting errors. All of this data is essential in determining the spinning reserve requirements of an interconnected system. In determining reserve requirements, it should be remembered that anything *can* happen, but that the useful solution to the problem lies in determining what *is likely* to happen over a certain *period of time* and in reaching a decision on how much one is willing to spend for protection.

To illustrate a hypothetical case, assume that statistics indicate that the average turbine failure is once every seven years, or once every 61,320 hours. Furthermore, assume that the average failure of a vulnerable boiler (one having a direct bearing on turbine output) happens twice every year or once every 4,380 hours. Then the probability of losing any particular turbine and any particular boiler in the same hour is

$$\frac{1}{61{,}320} \times \frac{1}{4{,}380} = \frac{1}{268{,}581{,}600}$$

or once every 30,660 years. However, if there are 100 turbines and six vulnerable boilers, the equation becomes

$$\frac{100}{61{,}320} \times \frac{6}{4{,}380} = \frac{600}{268{,}581{,}600}$$

or approximately once every 50 years that some turbine and a vulnerable boiler will fail in the same hour. Under this assumption, a combined boiler and turbine failure would occur during the

* From paper presented at recent meeting of E.E.I. Electrical Equipment Committee in Cincinnati.

daily 1-hr. peak once every 50 years, but the largest boiler and largest turbine would fail simultaneously on peak only once every 30,660 years. This is only part of the answer since no consideration has been given to load forecasting errors.

Probabilities Determined

In Fig. 1a is shown an actual probability curve covering load forecasting errors on a large interconnected system. In order to straighten the curve, it has been drawn on probability paper. This particular curve applies to evening peaks on weekdays only. After deducting holidays there are approximately 250 of such peaks every year or about 1,000 every four years;

$\frac{1}{1,000}$ equals 1/10 of 1 percent

and the probable error which will occur once every four years can be read where the curve crosses 99.9. Assume that experience shows this to be 7.2 percent.

The load forecasting error factor can now be included in the formula. The formula involving the largest turbine and the largest vulnerable boiler in itself gives such a remote probability that no further consideration of it seems necessary; however, the formula for the loss of any turbine on peak, on the day of a 7.2 percent load forecasting error, would appear as follows:—

$$\frac{100}{61,320} \times \frac{1}{1,000} = \frac{100}{61,320,000} = \frac{1}{613,200}$$

or about once every 70 years, while the probable loss of a vulnerable boiler on the day of 7.2 percent load forecasting error would be shown:—

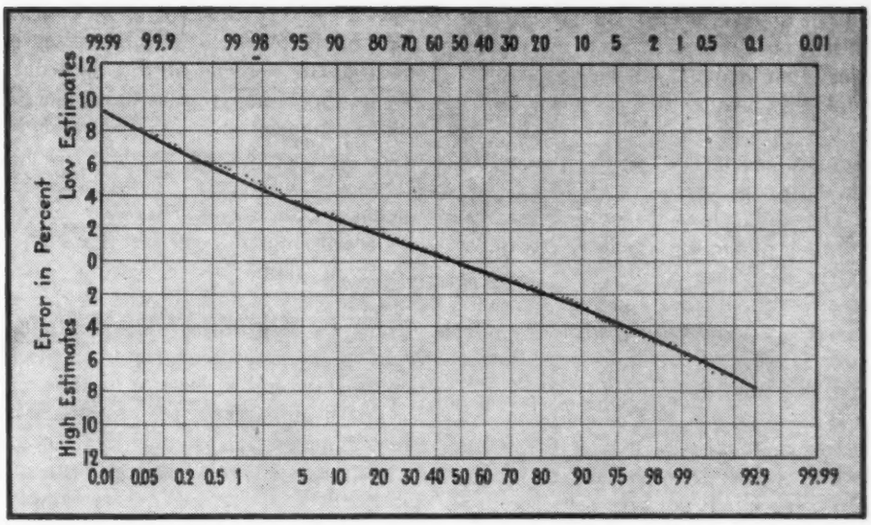
$$\frac{6}{4,380} \times \frac{1}{1,000} = \frac{6}{4,380,000} = \frac{1}{730,000}$$

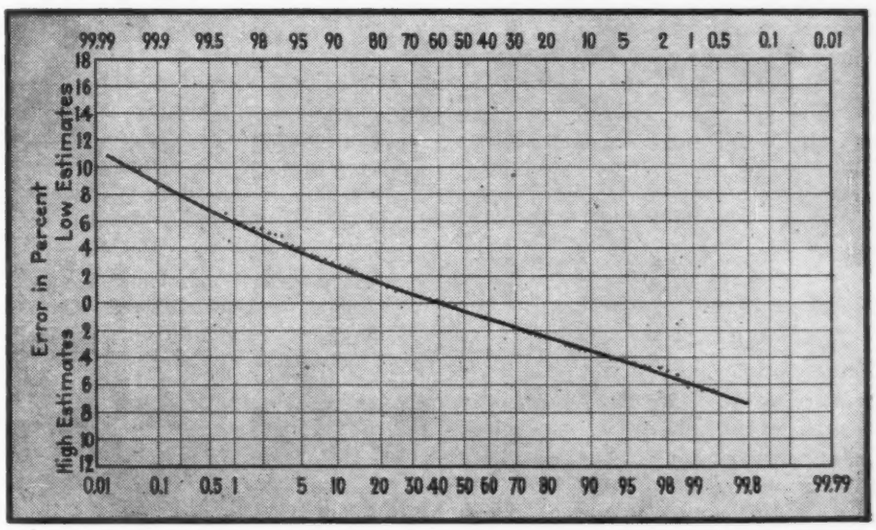
or once every 83 years.

Obviously in this hypothetical case, the load forecasting error is a great hazard at the time of the daily peak. Reserve of 7.2 percent will protect the system for a four-year daily load forecasting error, while if the reserve is increased to 8 percent, it will protect the system against the worst error that will probably occur in eight years.

Weekday Errors

In Fig. 1b is shown another probability curve for the same system but covers load estimating errors for a.m. peaks only on weekdays. It will be noted that the curve crosses 99.9 at 8.7 percent and this is the reserve re-





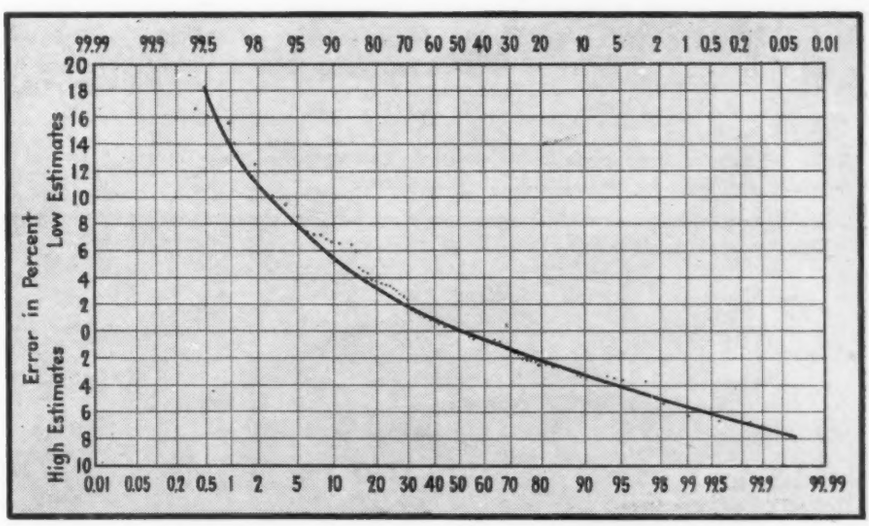


FIG. 1—Probability of error in forecasting load on a large interconnected system;

(a)—(Top) Weekday p.m. peaks

(b)—(Middle) Weekday a.m. peaks

(c)—(Bottom) Saturday a.m. peaks forecast are least reliable but also only one-fifth as frequent

quired to cover a load estimating error with a probability of occurrence once every four years. If it is desirable to extend this probability to once every eight years, it would be necessary to increase the reserve to 9.6 percent of the daily a.m. peak.

The higher load forecasting error at the time of the a.m. peak is attributed to the fact that the evening peak is created by darkness and that the main variable is temperature, while the a.m. peak is affected by both temperature and sky conditions.

It is advisable at this point to call attention to the fact that the selection of a four-year probability for the a.m. peak might not give the same protection of a four-year probability for the evening peak. Once again the time element should be considered. If the morning peak were three times as long as the evening peak, the possibility of machine or boiler failure during its duration would be three times as great and for that reason it might be desirable to give more consideration to the combined probability of equipment failure and load forecasting error.

Saturday Errors

In Fig. 1c load forecasting errors for Saturday mornings on the same system are shown. Obviously these forecasting errors are worse percentage wise than those for the other two periods; however, the discrepancy is not as great as it might first appear. There are only about one-fifth the number of Saturdays in a year as weekdays so that a frequency of every four years would be one in every 200 or where the curve crosses 99.5. Protection against such a probability would require reserve equal to 16 percent of the Saturday morning peaks. If it is desirable to increase the frequency to eight years, it would be necessary to increase the reserve to 18.0 percent. The higher load forecasting errors on Saturday mornings are attributed to the fact that many industrial plants whose lighting load does not vary materially with sky conditions are shut down, while the lighting and temperature variable in residential service is at least as high as on weekdays and, therefore, represents a greater percentage of the total load. In determining reserve requirements for Saturday morning peaks, ample consideration should be given to their duration.

Probability an Average

In working with probability data, one should always keep in mind the fact that extreme conditions may happen at a more frequent rate over any short period of time than is indicated as the average for an extended period of time. That is, probability data may indicate a certain condition to occur once every ten years, while in practice it may happen two years in succession, and not occur again for 20 years.

In comparing reserve standards of different companies or systems, care should be exercised to take into consideration the methods employed in measuring peaks. Although the load estimating errors may be practically identical on two different systems, the same amount of reserve would not necessarily give the same protection to a system which measured its peaks by hourly integration as it would to one which recorded peaks on an instantaneous basis. This again illustrates how duration of the peak period is an essential factor in determining reserve.

Cold Reserve

Up to now we have discussed only the spinning reserve requirements of a system at the time of the daily peak. It has been assumed that the load on either side of the daily peak will be lower than the peak by an amount at least equal to the largest unit and that the reserve provided for the load forecasting error on peak will provide for ample protection for the remainder of the day. If such is not the case, a peak load of longer duration should be taken into account.

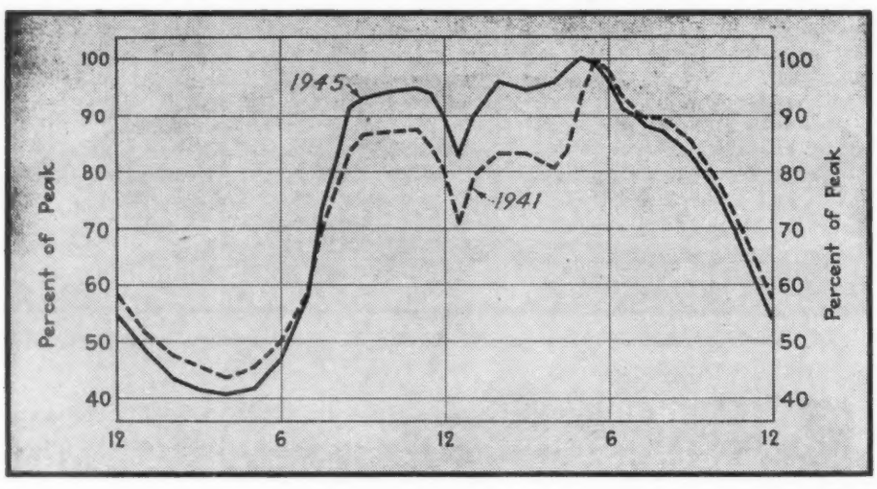
Once the spinning reserve requirement has been established, it is logical to proceed with the establishment of the cold reserve requirements. The cold reserve of an electric system constitutes the spare capacity that is necessary to cover forced outages of extended duration, yearly load forecasting errors, and other contingencies such as poor coal and depletion of hydro capacity.

Of the numerous contingencies that should be covered by cold reserve, forced outages generally occur with the greatest frequency. If the daily spinning reserve is to be maintained, ample spare capacity should be available to cover extended forced outages. By analyzing the company records over a number of years, the average forced outage can be ascertained, and this will constitute the minimum cold reserve that should be maintained. This amount of reserve will not, however, protect the system against multiple forced outages of a severe nature. The amount of protection afforded depends directly on the frequency of the hazard that is decided to protect against.

Frequency of other contingencies, such as poor coal and depleted hydro capacity, is so low that the probability of their occurrence simultaneously with severe, multiple forced outages is remote, and as a result many companies will probably decide against extra protection against them. Scheduled maintenence can be delayed should this remote probability actually occur.

Installed reserve requirements of an electric system may in some cases be no more than the sum of the spinning and cold reserve. If the installed capac-

FIG. 2—Approaching equality of morning and evening peaks means a loss of capacity available to accommodate maintenance



Basis for Interconnection Reserves

The following functions should all be considered in arriving at the reserve requirements of an interconnected system:

1. Spinning reserve should be based on an analysis of combined probability of equipment failure and load estimating errors. The ultimate conclusion will depend on the frequency with which the system management is willing to tolerate riding over the peak with no reserve.

2. Cold reserve should be determined from the coverage required for extended forced outages, both singular and multiple. In addition, consideration should be given to low water, poor coal and yearly load estimating errors. The minimum cold reserve should be equal to the average forced outage.

3. Installed reserve requirements may only be equal to the summation of spinning and cold requirements, but consideration should be given to the monthly change in peak loads in order to ascertain if this change will provide for normal yearly maintenance schedules. The newer type installations require greater leeway for maintenance.

Anything can happen, and the magnitude of reserve which is carried depends on how much of a risk it is desired to take, and how much the management wants to spend on insurance.

ity is equal to the annual peak plus these two components of reserve, it may be adequate to cover all other contingencies. This condition has been particularly true in the past for systems with the greater part of their load centered in metropolitan areas.

Trend of Winter Peak

The large amount of lighting load that is characteristic of metropolitan areas generally creates an annual peak around 6:00 p.m. in the month of December, but as the days get longer the evening peak drops off rapidly and by March or April is less than the daytime peak. In the past, this drop in the magnitude of the daily peak has generally been sufficient to furnish adequate excess capacity in the spring and summer to handle the normal maintenance schedule. This condition may not continue in the post-war period.

An example of the change in the shape of the November load curve for one particular system, between 1941 and 1945, is shown in Fig. 2. In 1941, the day load was 12½ percent below the evening peak, while in 1945 it was 5½ percent below the evening peak. It is not known at this time whether this condition will continue, but if it does, there will be a loss of capacity equivalent to 7 percent of the load, which might otherwise have been used for maintenance in the spring and summer. In this particular case, had the installed reserve been just sufficient to cover the winter peak plus spinning and cold reserve requirements, there would be insufficient spare capacity available in the spring and summer to handle the normal maintenance schedule.

A large increase in summer loads may be experienced in air-conditioning and other cooling applications. If this forecast is realized, still less spare equipment will be available in the summer to handle maintenance schedules.

Additional installed capacity may be necessitated by the modern boiler plant design. Boilers must be taken out for inspection once every year, and some companies follow the practice of taking them out twice a year. It does not take much capacity of the modern type of equipment comprising one turbine and two boilers or one turbine and one boiler to absorb a very large proportion of the spring and summer load drop when maintenance is undertaken.

With present load trends and modern design of equipment, it is quite possible that many companies may be forced to install extra capacity in order to handle maintenance schedules. At the present time this condition is emphasized by the fact that many companies are doing scheduled maintenance at the time of the yearly peak. Such a procedure was almost unheard of on metropolitan companies prior to World War II.

In determining installed reserve requirements it is therefore necessary to consider changes in load shape and maintenance requirements as well as spinning and cold reserve requirements.

• • •

Water Powers of the World

Of the total developed water power in the world, 77,800,000 hp., about one third, 24,223,000 hp., is in the United States. Potential water power, based on ordinary minimum flow, of the world is 667,000,000 hp., of which only 33,500,000 hp. is in this country.

These figures are from a recent statement released by the U. S. Geological Survey (No. 124,873) entitled "Developed and Potential Water Powers of the World."

The figures of developed and potential power are not directly comparable because the former is the sum of installed capacities which average 2 to 3 times output capabilities at the minimum flows of the developed sites. The potential power at utilized sites in one European country, for example, amounts to only about 21 percent, while the installed capacity (developed water power) is 44 percent, of the figure for the theoretical water power resources of that country. (Despite this difference in terms, however, the data may be said to justify the conclusion that development of water power has been carried about nine times further in the United States than in the rest of the world.—Editor)

Previous to 1940 important waterpower projects were reported as being contemplated and under way in different countries of the Eastern Hemisphere. Most, if not all, of these projects were discontinued because of the disruption of industry and transportation by World War II. In the Western Hemisphere, on the other hand, waterpower development has proceeded actively, especially in North America, and will probably continue, but at a greatly reduced rate. Development in nearly all other parts of the world should be accelerated.

MINIMUM HOUSING

R. E. HANSEN, *Mechanical Engineer, and*

Simplified semi-outdoor design saves approximately 10 percent of outlay—Duplication by recent extension of original plant after two years' successful operation confirms soundness and economy of design—"Outdoor" total reaches 500,000 kw.

HOUSTON LIGHTING & POWER CO. authorized the design and construction, for operation in 1943, of a 37,500-kw., 850-psi., 900-F. steam electric station of the semi-outdoor type, adopting minimum housing for equipment and maximum compactness and simplification of arrangement. One turbine-generator and one natural-gas-fired steam generator were installed. This plant has been giving reliable and economical service, at high load factor, for over two years. The company management, feeling satisfied with the general design and operation, and appreciating the relatively low development cost—less than $75 per kw. of net output capacity for steam plant proper, including site and improvements—has authorized an extension practically duplicating the initial construction. New layout is of the opposite "hand," giving a symmetrical arrangement of equipment.

A radical element in the design is broad use of semi-outdoor features, with Riley steam generator installed outdoors except for housing of operating space, and with General Electric turbine-generator enclosed in a light removable housing on an open deck, served by a gantry crane. Fig. 2 is a general view of station. Walls are of concrete and windowless, forced ventilation being employed. Plant is built on a concrete slab, set on piles at ground level.

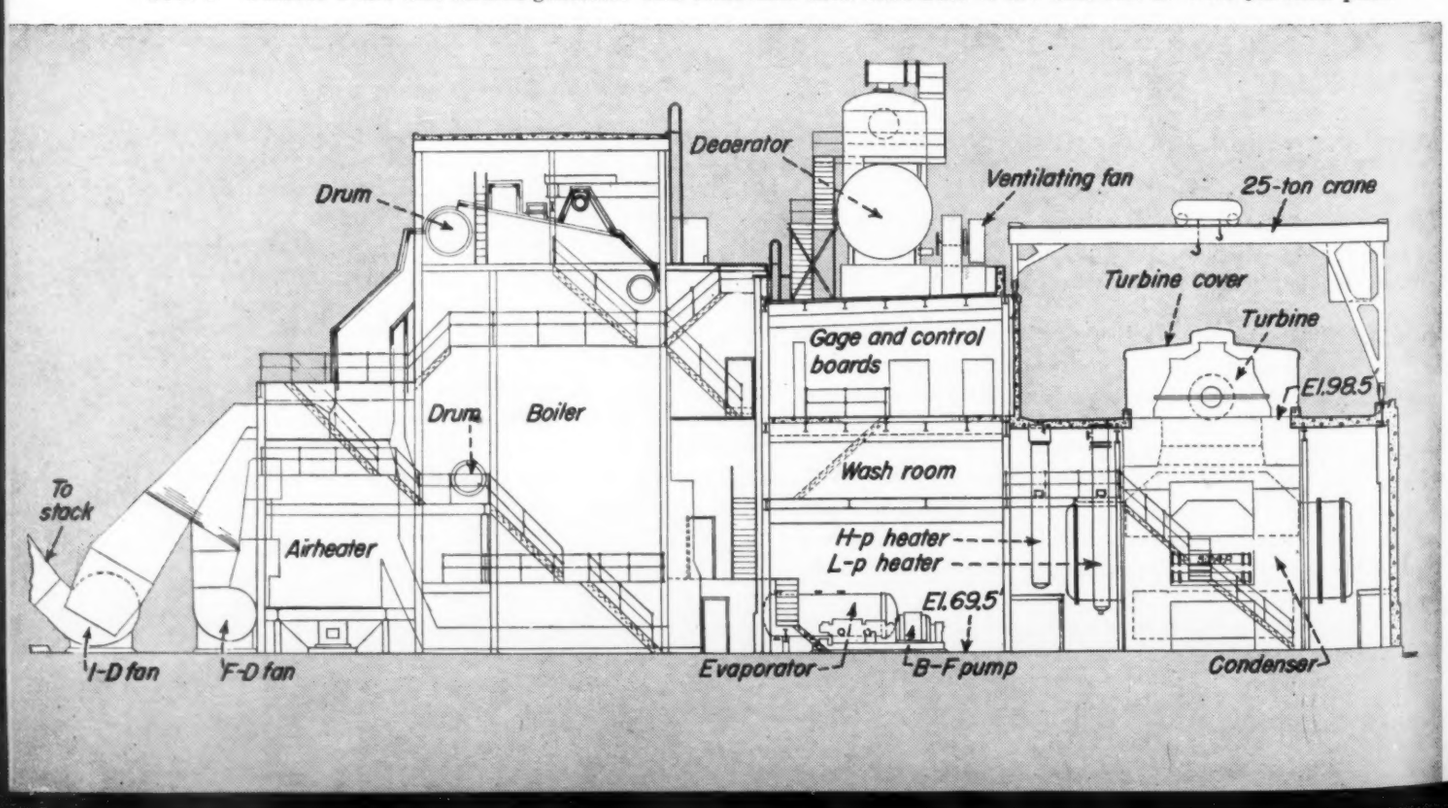
Net output during 1944 was over 285 million kw.-hr., corresponding to a load factor of 87 percent based on net capability of 37,500 kw. Extreme maximum net output was 42,000 kw. Plant economy for the year averaged about 12,750 B.t.u. per net kw.-hr. Increase in system load for the 30-year period from 1916 to 1945 exceeded even the rapid growth of Houston and vicinity.

In a broad plan of power development for the metropolitan area, the aim has been to avoid concentration of generating capacity and to start new plants as found economical, feeding into the well developed transmission system at convenient points and so located as to have available a fuel supply at moderate cost.

A site southwesterly from Houston was selected in 1928 for a transmission substation which was named West Junction; several important power lines met there. A steam plant at that location would tend to balance power production around Houston, considering the 150,000-kw. Deepwater Station to the east and the Gable Street Station in the heart of the city. It is favorably located with respect to natural-gas producing areas and pipe lines.

An unusual feature of the 1942-1943 West Junction construction, and the 1946 extension, is the adoption of semi-outdoor design. H. O. Clarke, vice-president and assistant general manager of

FIG. 1—Outdoor boiler and turbine-generator with removable shell contribute to low unit cost of West Junction plant



Employed for Low-Cost Houston Plant

LOUIS ELLIOTT, *Consulting Mechanical Engineer, Ebasco Services Inc., New York*

the company, took the broad point of view that the marked savings in investment and the simplification of operation fully justified the adoption of an unconventional design of plant. Operating and maintenance experience over the past two years and more has justified this decision, as shown by the adoption of the same type of design for the plant extension. As evidencing confidence in the use of outdoor features, consideration was given for the extension even to the adoption of a completely outdoor turbine-generator, omitting all housing.

Precedent for outdoor installation of steam equipment had been established at steel mills, oil refineries and other industrial plants. Electric substations and hydroelectric installations have for many years been of the outdoor and semi-outdoor type. Outdoor boilers similar to those at Gable Street and West Junction have given successful service in Utah, Kansas and Nebraska, as well as in areas with climate more nearly like that of Texas. General Electric's mercury-steam plant at Schenectady, and municipal stations at Burbank and Glendale in California, are of the outdoor type. More recently, the design has been adopted for five steam installations in Louisiana, Arkansas and Florida. Net output capability of installations of this character, built and under construction, designed by Ebasco Services Inc., engineers for Houston Lighting & Power Co., totals approximately 500,000 kw.

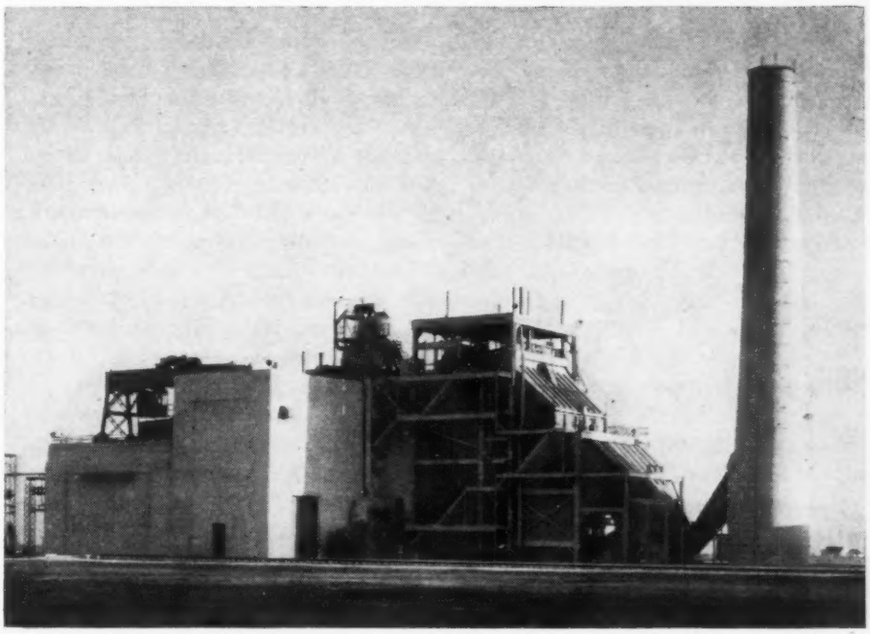


FIG. 2—Houston Lighting & Power Co.'s West Junction Station has 37,500-kw. unit in semi-outdoor structure. The Foster-Wheeler forced-draft cooling tower (18 cells, 162 by 60 by 28 ft. over-all) not shown

Savings Possible by Semi-Outdoor Construction

With reduction in costs of energy production by steam generating stations, the item of fixed charges on plant has become relatively more important in influencing total cost of product. Increasing costs for operating and maintenance labor also make it important to select a type of plant utilizing labor as economically as possible. The compact semi-outdoor type of plant achieves both these ends, substantially reducing investment as compared with the conventionally housed station design, and simplifying operation by virtue of compactness and convenient location of operating controls.

The keen competition in power supply to be expected by the public utility industry, together with expectable cost and other conditions over the coming years, make it particularly important to examine all items in plant design and construction and to achieve maximum simplification and minimum investment cost.

It is difficult to state exactly how much was saved at West Junction by the plant's semi-outdoor character. Every station has many distinctive elements that tend to reduce or increase first cost, and it is impossible in comparing two plants to segregate any one element and appraise its effect on overall cost. In the case of the initial West Junction installation, for example, erection was carried on during the war, when labor and material costs were high. Substitute materials had to be used without much regard to price. Delays resulting from priority regulation, and from transportation difficulties, added to cost.

With these factors taken into account, the unit cost of the original 37,500-kw. West Junction steam plant (below $75) may be considered quite low. Unless price levels advance well beyond those obtaining during the initial construction, extensions will reduce the unit cost of entire plant. Such low costs cannot, of course, be achieved in all cases; a coal-fired station, for example, costs much more than one utilizing natural gas as fuel.

Approximate data on building volume, floor area, and quantity of steel required are given on the following page, comparing the initial West Junction as actually constructed, and a plant with similar equipment but erected with full housing. Quantities given for latter are, of course, rough estimates, but doubtless

	Conventional Plant	West Junction	Reduction, Percent
Building volume, cu. ft.	1,200,000	300,000	75
Floor area, sq. ft.	30,000	15,000	50
Steels, tons			
Structural	1,200	400	67
Reinforcing	400	450	—12
Total Steel	1,600	850	47

fall somewhere in the rather wide range covered by different conventional design types.

Structural-steel quantities include floor gratings, walkways and stairways. Quantity of reinforcing steel shown includes all required in plant, for equipment foundations, substructure, and cooling-tower basin; increase results from use of reinforced concrete for exterior walls and floors, resting directly on foundation slab. At time design was worked out, structural steel was a critical material.

Net saving through adoption of the simplified outdoor design employed at West Junction, as compared with the conventional design, is estimated at well over 10 percent of total plant investment. This figure applies to first unit installed at a given site. For subsequent units of same size, the dollars saved may be less, but these will represent at least as large a percentage of the total.

Arrangement of Equipment

Although both boiler and turbine are semi-housed, a building aggregating 300,000 cu. ft. is provided, including condenser (Lummus 36,000 sq. ft.) space under turbine, auxiliary bay, and boiler firing aisle. Ground area covered by building (Fig. 2) is under 8,000 sq. ft., and enclosed floor area about twice as much. Turbine-generator is on an open deck forming roof of condenser room, and is covered by a removable sheet metal housing. One leg of Whiting 25-ton gantry crane rests on outer wall of condenser room, with opposite leg running along roof of auxiliary bay, on which is placed the Elliott deaerator. Vertical feedwater heaters are under roof of condenser room, with tube bundles removable by crane.

To be successful in operation, an outdoor plant should be designed to permit nearly all regular duties to be performed from a few central points, protected from the weather. Such locations include boiler firing aisles, boiler turbine and electric control room, and space for certain auxiliaries. A by-product of centralized control is that few operators are needed. West Junction is operated by three men per shift. Total operating force of the initial 37,500-kw. plant, including provision for weekend, vacation and absence, includes 18 men. This will be increased to 22 men after second unit is installed.

Control room is located at same level (Fig. 1) as turbine deck, and is connected with turbine house by a covered passageway. At opposite side is enclosure at front of boiler; it is necessary only to descend a stairway to reach burner platform. Boiler and turbine gage-boards, control switchboard, hydrogen controls and boiler controls, are all located in the one room, which also contains main steam stop-valve, as well as handwheels and pushbutton controls for other valves.

Major maintenance work is done by men from a maintenance "pool," at the Deepwater plant. It is too early to draw conclusions as to cost of maintenance of the West Junction type of station, compared with heat for a conventional plant. During early life of a plant many minor alterations are made to improve operation, but on the other hand heavy maintenance jobs are seldom necessary. There is doubtless a substantial reduction in building maintenance, as compared with a fully housed design, which may be in part offset by some slight increase in cost of overhauling semi-outdoor equipment.

Turbine-generator is covered by a light metal removable housing. The latter is divided into sections, so that turbine casing, generator rotor or one generator end-bell can be handled by crane, without exposing entire unit. Top sections can be removed without disturbing sides. Walls along first turbine unit are removable, but it has been found by experience that they can well be made permanent. Second unit will be placed in a continuation of present housing, with turbine ends together and wall at turbine end of present unit removed. Sides will be permanent, but will match present walls in appearance; end will be removable to permit withdrawing generator rotor.

Original building was constructed without windows, primarily for blackout purposes. While it was realized, of course, that over the greater part of life of plant there would be no necessity for blackout, it was not considered worth the added cost to make provision for inserting windows later. In view of the minor economic difference between windowless construction and use of windows, the blackout features will be carried over into future extensions. Operators have not complained of being "shut in."

Lighting and Ventilation

Artificial lighting installation in a windowless building need be no more elaborate than in one with windows. It is, moreover, seldom possible to design a natural lighting system such that building occupants can work without artificial illumination during the day; consequently, there is little difference in daily energy consumption between part-natural and all-artificial systems.

Ventilation must be accomplished by fans if windows are not provided. Present West Junction station is served by 17 fans, exhausters and ventilators, with complete system of ducts. Cost of this provision need not be assessed against this type of construction, as many modern plants of conventional design employ forced ventilation, to reduce discomfort from excessive temperature. With a fully enclosed plant having four times the volume, cost of ventilating would be higher.

Evolution of the outdoor steam plant has taken place over the past fifteen years in a series of steps, of which West Junction is one of the more recent —but not the last. It is likely that future plants will employ even more radical measures, further to reduce plant investment. As an example, housing of condenser basement may be eliminated.

Ebasco Services Inc. has acted as engineer for Houston Lighting & Power Co., in general consultation and in designing and constructing the West Junction steam electric station.

Now's the Time to Sell Street Lighting

HENRY G. CLUM, *General Sales Manager, Art Metal Co., Cleveland, Ohio*

IN THE PAST twenty years, electric power companies have only half-heartedly engaged in selling street lighting. After early efforts in promoting this load to increase energy sales and revenue, frequently the utilities found that the program was not profitable and in many cases the load actually proved to be an economic burden. There were no immediate or short-term results, so street lighting was placed on a shelf. There have been important exceptions to this experience, where street lighting has proven itself a real revenue builder. Utilities with foresight and determination in planning a program have made street lighting pay, have replaced obsolete equipment with more adequate lighting and have installed initial systems in new areas.

The Illuminating Engineering Society has issued a forecast of the postwar market in street lighting energy. Present day street lighting uses approximately 2,000,000,000 kw.-hr. per year. To light the streets in cities and towns of the United States with adequate illumination on main arteries, secondary arteries, in business districts, at dangerous intersections, bridges and approaches and in residential districts according to the I.E.S. code will require 8,000,000,000 kw.-hr. Therefore, 6,000,000,000 kw.-hr. per year will be added to street lighting energy sales. As a result, revenues from this business will be increased over 300 percent or from $75,300,000 to about $230,000,000. Street lighting revenue, which in the past has been far down on the list of electricity sales, would advance to a point where it would account for 7 percent of the total.

Few people have ever seen a well lighted street. This statement may be challenged by some who will point to outstanding examples of street and highway lighting. Nevertheless, by far the greater majority of the public have yet to see an installation which will demand their conscious attention to the equipment or its effect. Over 60 percent of the 2½ million street lighting units in this country are of 1,000-lumen rating or less, the approximate equivalent of a 75-watt lamp. It is really amazing that a light source no longer considered adequate for a 10 by 12 kitchen is expected to light several hundred feet of 50-ft. roadway. The individual has an intimacy with indoor lighting which he does not feel out of doors. Therefore, it seems logical to assume that considerably more lighting would be needed outside to command the same attention as inside. In view of the acknowledged benefits which have accrued to the users of 50 or even 100 foot-candles indoors, it seems almost time that someone should screw up courage to try a 5- or 10-foot-candle street lighting job just to see the public's reaction. And if such lighting should find acceptance, the revenue estimates of the preceding paragraph would be ridiculously low.

If there be truth in the belief that street lighting business does not pay, ways must be found to make it earn a legitimate return. Rate adjustments are generally out of the question and only three alternatives are open:

A. Add something of value to the service to justify a higher price.

B. Increase the sale.

C. Reduce the cost to render the service.

At the moment there does not appear any radical new technique or light source which offers any particular hope of justifying a higher price for the service. Therefore, that alternative is eliminated from this consideration.

Large potentialities in energy sales and revenues, not too difficult of realization, plus possibilities of cost reduction, make street lighting an attractive load whose benefits can readily be sold

The problem of increasing sales can be attacked from two directions. The first and most obvious way is to replace lamps of 1,000 lumens or less with larger sizes yielding a higher return. The Illuminating Engineering Society's Recommended Practice of Street Lighting indicates very clearly that anything less than a 2,500-lumen lamp makes no sensible contribution to safety or to convenience on the street. It may then be argued logically that each of the approximately 1½ million small lamps should be increased to at least 2,500 lumens. This step alone would add from 15 to 20 million dollars to utility revenues, at the most conservative rate differential between the

two sizes. To make it more attractive, this program would add very little to cost. Capital and maintenance charges, estimated to be about $25 for the 1,000-lumen lamp, would be increased only about $1 per unit.

The second approach to increase sales is through bringing urban streets and heavily traveled highways up to the conservative I.E.S. recommendations. This obviously requires several times as many units as are now in use and with substantially larger lamps. The potential business which lies in this approach was indicated earlier in this article and is estimated to be from 100 to 150 million dollars per year exclusive of highway lighting.

Sell Benefits, Not Systems

The public has to be sold on the benefits to be received from adequate street lighting. The people at large are not interested in the number of poles, in the candlepower of lights or in transformers, but in the over-all effect adequate lighting will have on their daily lives. Detroit in 1930 with a census population of 1,568,662 spent $1,430,561 for street lighting or 91 cents per capita, which expenditure includes all costs for operation, maintenance, depreciation and interest. The system at that time included 28,000 street lamps with an average light output of 4,300 lumens per lamp.

Ten years later, or the end of 1940, found Detroit with its street lighting on the major portion of its heavy traffic thoroughfares rehabilitated into a traffic safety lighting system, with many additional lamps installed on lesser thoroughfares and residential streets. The lighting system in 1940 operated a total of 40,121 street lamps with an average light output of 6,983 lumens per lamp. In the fiscal year ending in 1940, Detroit with a census population of 1,618,549, spent $1,640,341 for street lighting, or $1.02 per capita, as compared to the expenditure of 91 cents in 1930.

Detroit's street lighting modernization program for its primary and secondary thoroughfares is approximately completed. However, the program for rehabilitating and modernizing the street lighting in most of its residential sections and local areas is only begun. When these programs are completed, it is estimated, the cost per capita will not exceed $1.35.

The citizens of Detroit have been sold street lighting. The target of an excellent promotion campaign by the municipal light department and local utilities, these citizens, alarmed by the ever increasing traffic fatalities, were willing to pay for better lighting when they were shown that adequate installations caused a 64 percent decrease in night traffic fatalities.

Some utilities have started new programs in cooperation with municipalities, with increased revenues from street lighting as results. Modernization of the City of Boise street lighting system promoted by the Idaho Power Co. produced a $10,000 increase over former revenues, plus the amount of a rate reduction. The new program increased the street lighting budget of the city only 4 percent but the up-to-date system will give the taxpayer 16 percent more light and will save the city about $500 annually in maintenance alone. The new street lighting rate schedules provide for maintenance of underground cables, post painting, lamp renewal, cleaning and replacing broken globes and bulbs by the power company.

The Empire District Light Co., of Joplin, Mo., recently announced a new plan which combines street lighting and franchise taxes in one contract. Discounts are given on the street lighting rate schedule equivalent to 100 candlepower of free city lighting for every ten new customers added to the utilities' lines and contingent upon the company having franchise rights for at least ten years.

Service Costs Must Be Reduced

The problem of reducing cost of service involves some objective thinking in regard to well rooted practices and policies. Space does not permit a detailed discussion of all of these practices but a few examples will indicate the general direction this investigation should follow. It is the writer's opinion that less of careful planning, of careful purchasing, installing and operating, is to be seen in street lighting than in any other class of utility business. The time has arrived when the luxury of poor engineering can no longer be afforded. To illustrate, consider the series circuit which is used in a high percentage of all street lighting systems. This method goes back to the infancy of the public utility business and persists today in spite of the growth of complete distribution coverage in every community that is of any importance.

The constant current regulator, with its inherent inefficiency and poor power factor at any but full load, represents in many cases a duplication of capacity already available in distribution transformers. Series circuits have been permitted to wander hit or miss up and down the streets with very little attention to economy of wire and reduction of line losses. Frequently these circuits are contributors of additional trouble in times of storm. An instance is recalled in which nine miles of copper wire was used to serve one 60-candlepower light. In another case a study of several adjacent circuits revealed that over 25,000 ft. of wire could be removed by simple rearrangement of the system. In the same instance over 50 kva. of excess regulator and insulating transformer capacity was removed from service.

Changeover Is Simple

In many areas where continuous secondary neutrals are available a complete change from multiple to series operation is definitely indicated. Simple multiple control devices are now to be had and better ones are promised, permitting operation of lights from distribution secondaries. Where such a changeover can be effected there will be beneficial results in capital investment, operation and maintenance.

Another thorn in the side of utility operators has been the demand by overenthusiastic city planners and beautifiers for so-called ornamental lighting. The term is a misnomer, for in most cases it is neither lighting nor ornamental. In yielding to popular pressure the operator has been saddled with a heavy investment which in many cases duplicates existing distribution facilities and does not provide any significantly better lighting than might have been obtained from overhead units mounted on existing distribution poles. Utilities should stand firm against these demands unless the customer is willing to pay for the increased costs involved.

There can be no better time than right now, when our post-war world is in the making, for utilities to exert every effort to transform street lighting from an improfitable obligation into a profitable business. This can be done by selling its values in protection of life and limb and property and by reducing its costs by better engineering.

Simplicity of Substations Rests on

VOLTAGE STRATIFICATION

P. D. TUTTLE, *Assistant Design Engineer, Hydro-Electric Commission of Quebec, Montreal, Canada*

Number of physical levels for each voltage should be minimized for simplicity—How to deal with disconnects, and straight-through power flow—Specific criticism of common departures—The built-up substation can be improved in layout

SOME OF THE ACCEPTANCE of the unit substation for application in utility outdoor substations can be credited to its positive attributes and merits. But some of the progress of the unit substation can be credited to flagging interest in the "built-up" type of substation because of obsolete or poorly designed layouts that are troublesome to operate and difficult to maintain with safety. Were more such stations designed and built with one dominant objective in mind, namely simplicity, the unit type substation would have to exert itself more to clinch its superiority for each contemplated situation.

With this thought in mind—that simplicity should be the guiding ideal—some suggestions are offered with the thought that they will encourage recognition of the fact that simplicity means simplicity of construction, simplicity of operation, simplicity for safe maintenance and simple accommodation of extensions. One large factor in achieving simplicity is that of establishing a minimum number of physically stratified bus levels for the respective voltages involved.

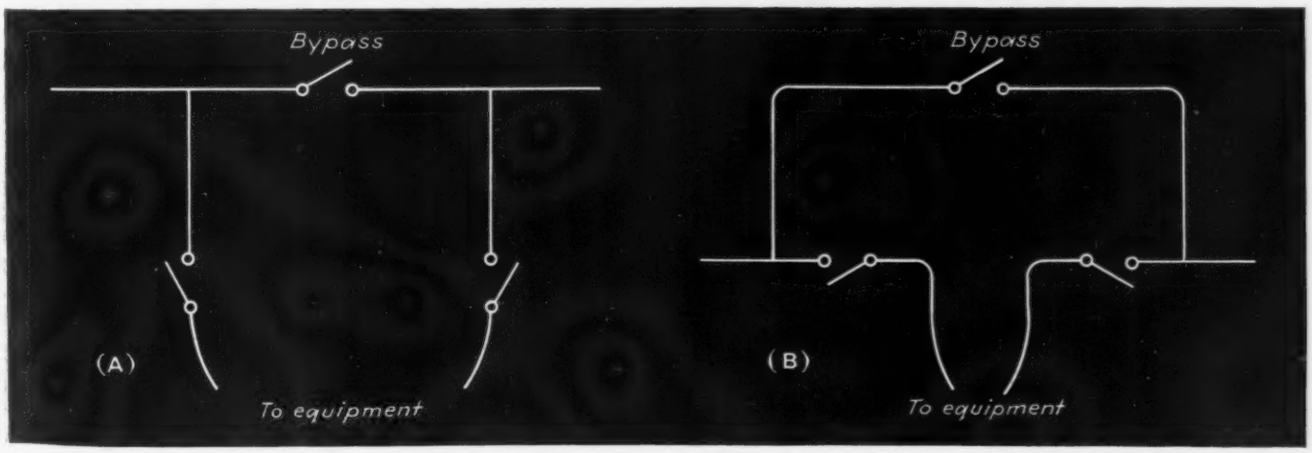
Concept of Levels

It has been found that even studied location of equipment does not necessarily result in simple buswork and neither does a bus layout suggest at all times the best equipment location. The two factors are definitely interdependent. However, keeping in mind the necessary clearances for handling the equipment, it is offered that the buswork is the better starting point in the design and that a more satisfactory layout is obtained by working "down" from the bus runs rather than "up" from the equipment.

The over-all view which the designer should have in mind when laying out buswork for a built-up substation is contained in the idea of "voltage and function levels" of which an explanation follows.

Buswork of any one voltage should be confined to two physical levels (as is usually possible) and certainly to

FIG. 1—Two typical arrangements of equipment disconnects and their effect on bypass installation. . . (A) Equipment disconnects below first bus level; no additional level needed for bypass. . . . (B) Equipment disconnects integral with first bus level: additional level required for bypass



no more than three. The change in level must be due to a change in function, not to a whim of construction. For the purpose at hand, the discussion will be confined to the outgoing end of a typical station, i.e., the feeder end. Then for example, the feeder buswork proper would be all on one level, the main and transfer buses at a second level, and so on back to the higher voltage levels of the station. We are assuming that the buswork at the lowest level is the least important, and that the higher levels progressively increase in importance. This is probably the most logical arrangement, but is not absolutely necessary.

Determining Factors

The initial level is determined by one of two factors. It can be set by the headroom needed from either voltage considerations or room needed to install bushings on the equipment. The other factor is the space required to install the disconnect switches adjacent to and associated directly with the heavier equipment (e.g. circuit breakers, regulators).

Levels of the higher voltage buswork can overlap those of the low voltage bus. For instance, the lowest level of the higher voltage bus may be conveniently that of the second level of the low voltage bus. It is often possible to make the lowest level of both voltages the same, but having the higher voltage buswork starting on a higher level has the advantage of immediately distinguishing between the two voltages. That is, having the sets of buses with their lowest levels different is a constant reminder leading to safer operation.

In the example shown in Fig. 2(B), the feeder buses proper are at level 1, the main and transfer buses at level 2. At the high voltage end of the station, which is not shown, the high voltage connections running in the same direction as the feeder buses could be at level 2 also, and the high voltage main bus would be at a higher level 3 determined by voltage clearances and equipment requirements between the high voltage main and transverse buses (e.g. disconnects, fuses).

This concept of bus levels may be summarized briefly; "a change in level should denote a change in function, a change in voltage, or a change in both function and voltage."

However, it is admitted that the converse is not strictly true even though desirable, that is, a change in function, voltage, or both factors does not necessarily incur a change in level. For example, there can be cases where buses having different functions may be at the same level if the layout is simplified thereby. Again, buses of different voltage may have the same lowest levels as mentioned before, although such a layout is not advised unless absolutely necessary due to, say, limited headroom.

This idea of "levels" may be carried into stations (usually indoor) where the interconnections between equipment are made with cable rather than overhead open bus. In this case the cables are considered as a theoretical "level." It can be seen that, as with an overhead bus, two or more voltages or functions can run on the same cable "level," but distinct from overhead buses, different functions may run in the same "level" *between the same points*. By using cable interconnections outdoors, the designer can obtain extra working "levels" with no increase in structure height.

By the use of this concept of "levels," the designer can immediately estimate if certain desired changes are possible in a given layout. For example, if it is desired to add a transfer bus where none exists, the designer must have the use of at least one level on the existing structure or, of course, be able to add one. If he is unable to do this, he must make his interconnections with cables.

Disconnect Switches

Disconnects connected to a level higher than the first and at such a point that buswork on a lower level intervenes between them and the operator are always more conveniently worked as a group. In preliminary estimates it is safest to assume all disconnects above the first level as gang-operated, even though the layout may eventually result in removal of intervening buswork. All disconnects in or below the first level may be individually hook-stick operated if so desired.

Bypass disconnect switches are in a variable position in regard to levels. (Figs. 1(A) and 1(B).) If the equipment disconnects proper are below their bus level as in (A), then bypass switches can be incorporated in the layout with no extra level room. If however, the equipment disconnects are in the bus-run proper as in (B) (an arrangement more commonly found indoors), then the addition of bypass disconnects requires an additional level.

Connections and Taps

Other points seem to be very obvious, yet it is probably because they are obvious that they are dismissed lightly too often with consequent awkward results. For instance, consideration should be given to bus connections and taps. The long lengths of bus are usually assumed to be straight but the short connections and taps should be just as straight and direct wherever possible. Naturally bends will be required, but the layout should be studied to obtain a minimum. Moreover, only single bends should be used, avoiding S-bends and U-bends which should be eliminated as far as is economical. In angle, channel, and edge-flat bus, a change of direction usually means a joint, and the striving for simplicity to avoid joints in bus runs using these shapes similarly simplifies the tubular layout. Material saved may be little, but erection time and labor cost are other factors influenced by straightforward design.

The designer should keep in mind the standard lengths of bus copper and make maximum use of the maximum lengths. If the bus run must extend beyond a standard length, care should be taken in locating couplings.

Fig. 2(A) shows a cross-section of a typical feeder layout using tubular bus and containing a few of the more common faults. In Fig. 2(B) the same electrical arrangement is laid out to agree with some of the ideas put forth. It should be kept in mind that these diagrams have been rendered semi-schematic and as simple as possible to allow for clarity in the small size reproductions.

(1) In Fig. 2(A), the poor design has resulted in having three physical levels K1, K2, and K3 where there should be but one since the buswork in these three runs is, in this case, all in the same theoretical "level." For a similar reason, the two levels L1 and L2 should be merged into one. Both of these changes have been made in Fig. 2(B). It is not customary to count as a separate level the horizontal portions of the bus taps as at M in Fig. 2 (A). This must be so because the buses may easily be constructed in a vertical plane in which case we would have three different levels for the bus taps even

though the bus remains in only one theoretical "level" no matter what its formation.

Column Heights

An interesting though perhaps not very important point is the equalization of column heights in the steelwork of Fig. 2(B) over that of 2(A). Although it may not be practicable, this raises the idea of standardizing on a definite set of column lengths for any certain voltage. This may be of some use where a large, rapidly expanding system has a number of substations under construction at one time. Standardization in this respect is going no further than does the unit type of substation, and would bring design and construction closer to an assembly routine.

(2) Position of the main and transfer buses can easily be located so that the tap from one phase down to the disconnects can be free of bends. By having this tap the one to the middle phase, it is seen that the taps to the outside phases are identical, which makes their prefabrication that much simpler. At the same time, one no longer has to check the clearance at F between the taps and the D runs and can locate D as required at any height. Moreover, assuming only some of the feeders installed initially, the buswork for later, additional feeders can be erected with greater ease and safety.

Straight-through Bus

(3) This shifting of the main bus has a more important consequence in that it allows the feeder bus to run at a constant height throughout its whole length. There is no reasonable excuse in Fig. 2(A) to have portions D and E of the feeder bus running at different heights. They are in the same theoretical "level" and it only requires a little careful planning to draw up a design having them at the same physical level as well. Portion C of the buswork is the run to the main bus from the low side of the transformers or from the transformer bank breakers. It is shown at the same level as the feeder bus but may be more conveniently tapped off above the main bus rather than below if the transformer height necessitates. This run is a separate entity which can easily be considered as having a "level" of its own.

(4) Connections at G could be revised to eliminate S-bends at this point. Before Fig. 2(A) was simplified for reproduction, there existed a slight S-bend in the tap from the upper disconnect to the lower due to the upper switch being group-operated and the lower a hook-stick model which had a different base-to-terminal-pad height. But this can be eliminated by only a slight modification of the supporting steel (e.g. a simple "padding" subplate under the lower switch). The two tees at this point G should be replaced by a cross-connector which is just as effective. Note that it may be preferable to have the run E continuous from the regulator bypass to the pothead column if more effective use can be made thereby of a standard length of bus.

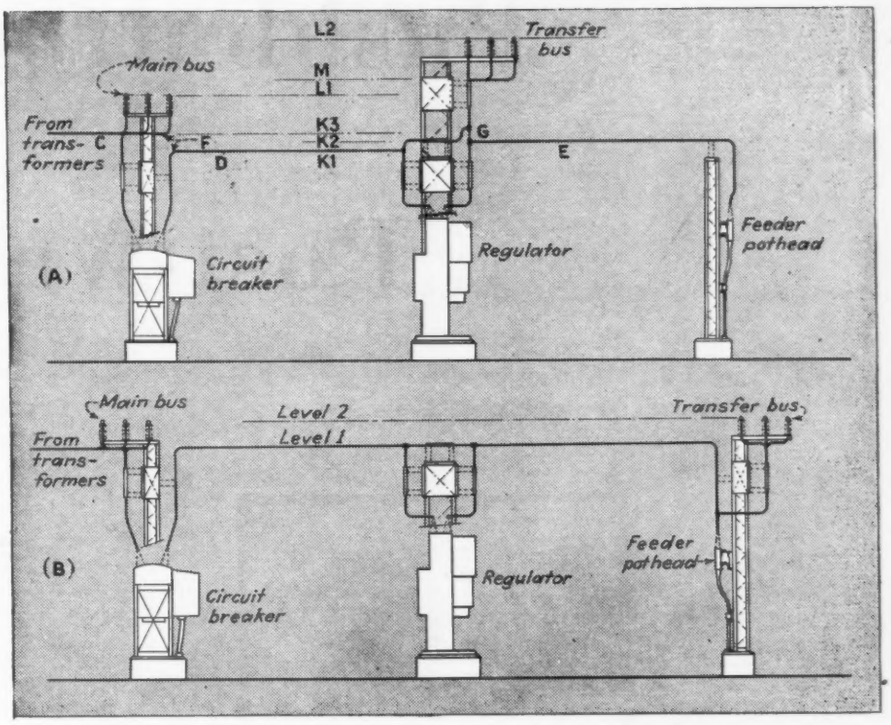


FIG. 2—Effect of applying "level" concept to typical outgoing feeder bay of substation. . . (A) Buswork built up from pre-located equipment . . . (B) Number and spacing of bus levels first determined: buswork then built down to equipment spaced as required

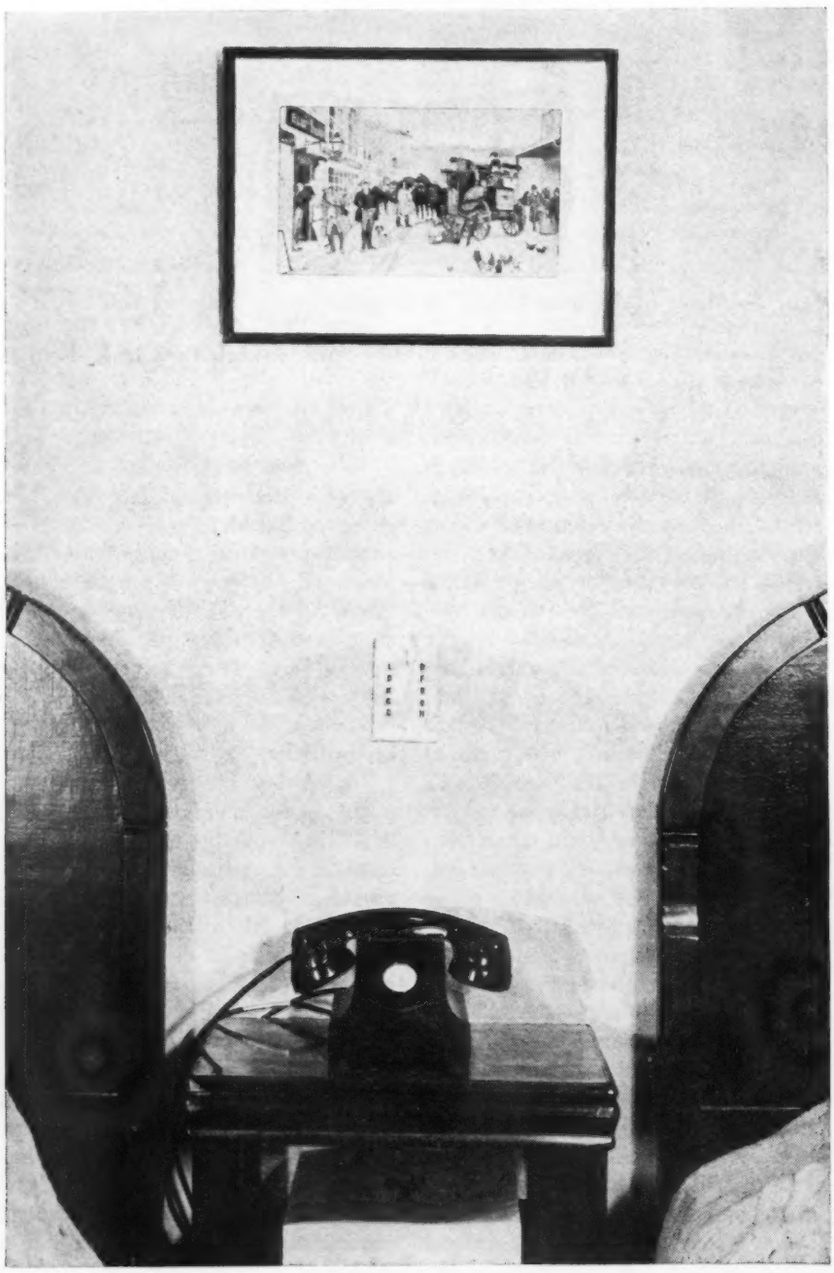
(5) Relocation of the transfer bus to the pothead structure from the regulator structure eliminates the piled-up effect on the latter and results in a much lower over-all arrangement. This is the consequence of redesigning to make maximum use of the second "level" of buswork as set by the actual height of the main bus. It will sometimes be found that an additional physical level is necessary for the horizontal portions of taps between buses if the use of cables must be avoided. (Refer again to point 1 of this discussion of the illustrations.)

Note that the design of 2(B) is the more economical of the two. The amount of steel, it is true, remains approximately the same; the pothead structure has been strengthened, but the regulator structure has been lightened considerably. However, the real saving arises from being able to use hook-stick operated disconnect switches to the transfer bus instead of a group-operated set.

(6) A last but not entirely immaterial improvement of layout 2(B) over 2(A) is the better esthetic effect produced. The redesign is much neater and less obtrusive, a quality to be considered where the station is in or near a residential district. Proponents of the unit station have emphasized the argument that equipment must be fully enclosed to look well. There may, however, be a difference of opinion here: to a designer with an eye to proportion and symmetry, an open structure with smooth-flowing bus lines can be made to appear quite graceful. Surely the functional beauty of the modern generating station must be carried into the design of substations no less appealing to the eye. The symbols of power must be made attractive to the public no matter in what form they appear.

Pushbutton Wiring

Post-War Homes

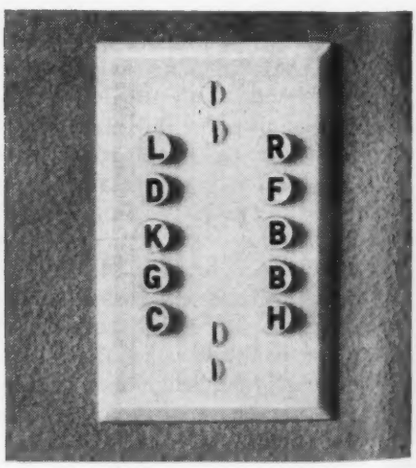


LIGHT is the burglar's or prowler's worst enemy. From this master-bedroom control lights in any room, garage, patio or garden may be turned on, or all may be lighted as fast as control buttons can be pressed

NOW GROWING in California is enthusiasm for a radical change in house wiring practice which its sponsors believe will give adequate wiring much glamour and popular appeal and make it as easy to sell—almost—as nylons.

The excitement is about a "Pushbutton Wiring System," not at all a novel idea, but one which has waited long to become practicable. It is exemplified in a model post-war home on display in Los Angeles. Switch legs and wall switches have been replaced by control wiring and pushbuttons operating small solenoid switches in lighting outlet boxes, termed "relays" for convenience. This pushbutton and relay system permits use of small-gage, low-voltage conductors in stapled wiring from control points to fixtures, in place of the ordinary 120-volt wiring. By limiting control energy supply to 50-va. transformer capacity, no protection for the control wiring is required under the National Electrical Code.

As said, the idea is not new. Such a



MASTER-BEDROOM control of all lighting at nominal cost is one of strongest selling points for system

System for

Wall switches and switch legs would give way to pushbuttons, relays and low-voltage control circuits in new residential wiring

system was tried out about 25 years ago but it had little success because of unreliability of contacting devices and cost of servicing. The industry has come a long way since that time and today, largely as a result of progress during the war period, there are available many forms of compact and reliable relays and contactors, developed primarily for use in airplane controls. It is a short step from these to a device suitable for installation in an outlet box.

Multiplicity of Controls

Advocates of the system point out many advantages claimed for it. They say that the public has been lead to expect new and glamorous things from wartime technological advances and that pushbutton wiring can meet that expectation. They assert that a third of the cost of present wiring goes into switch legs and that the saving by omission of them will pay for the new control system and still leave something over to pay for greater wiring adequacy. These enthusiasts point out that the system will provide a multiplicity of lighting controls, one at every doorway to provide a path of light through the house, and at insignificant cost. Further, it will satisfy a public demand by making possible at nominal cost master-bedroom control of all lights in the house for protection against burglars or for other emergencies.

Pushbutton wiring, with its unlimited control possibilities, is very simple, as is shown in Fig. 1. The 120-volt controlled circuits are run directly to the outlets where the relay—which is actually a small solenoid-operated circuit-closing and circuit-opening switch—is installed. All of the relays in the house are connected on one side to a common wire that goes directly to the secondary of a low-voltage transformer. The other secondary lead is connected to another common wire that runs to one side of all the pushbuttons in the house. Connection from the other side of each relay is carried to a terminal block and is connected across the block to all of the pushbuttons installed for operation of the particular relay.

Common Terminal Block

With coded or otherwise identified wires the terminal block serves as a convenient and necessary place for additions and servicing. Any number of pushbuttons can be connected to one relay, allowing not only the two- or three-point control of ordinary house wiring but an unlimited number. A master-bedroom control is connected on one side to the common wire from the transformer and on the other by separate conductors to the terminal block according to the circuits to be controlled. Low-voltage wires and cables, as small as No. 22, are used in the pushbutton circuits and, as stated, can be installed without protection like ordinary bell wires.

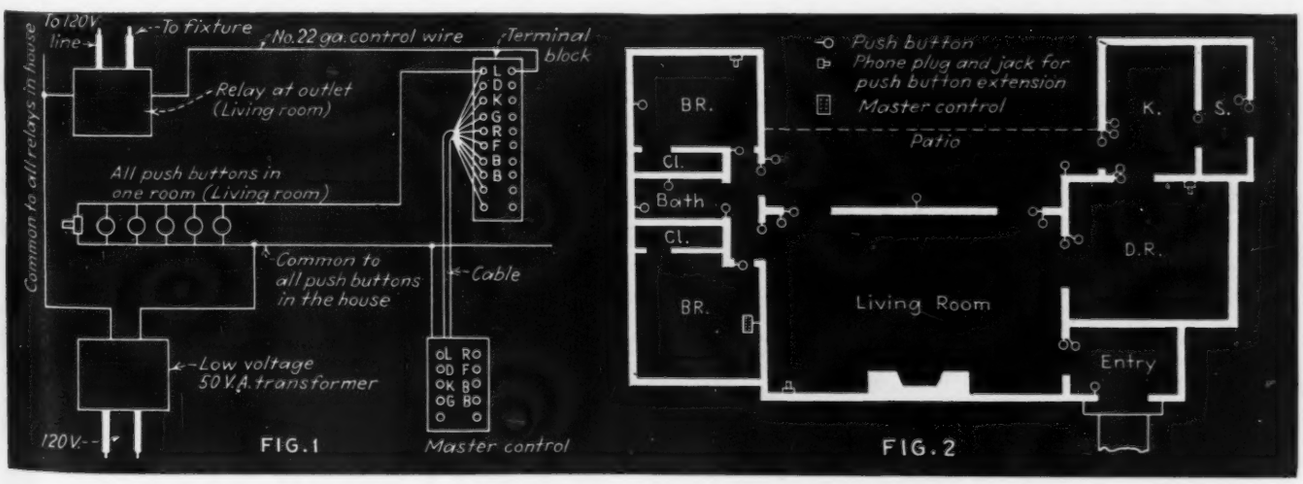


FIG. 1—Simple elements of low-voltage control system for house wiring using relays and pushbuttons in place of conventional switch legs . . . FIG. 2—Multiplicity of lighting controls at slight cost can provide a path of light through the house. Here is an example of how pushbutton controls and master control might be placed in a five-room house

FUSES FALL SHORT
*of Transformer Capabilities**

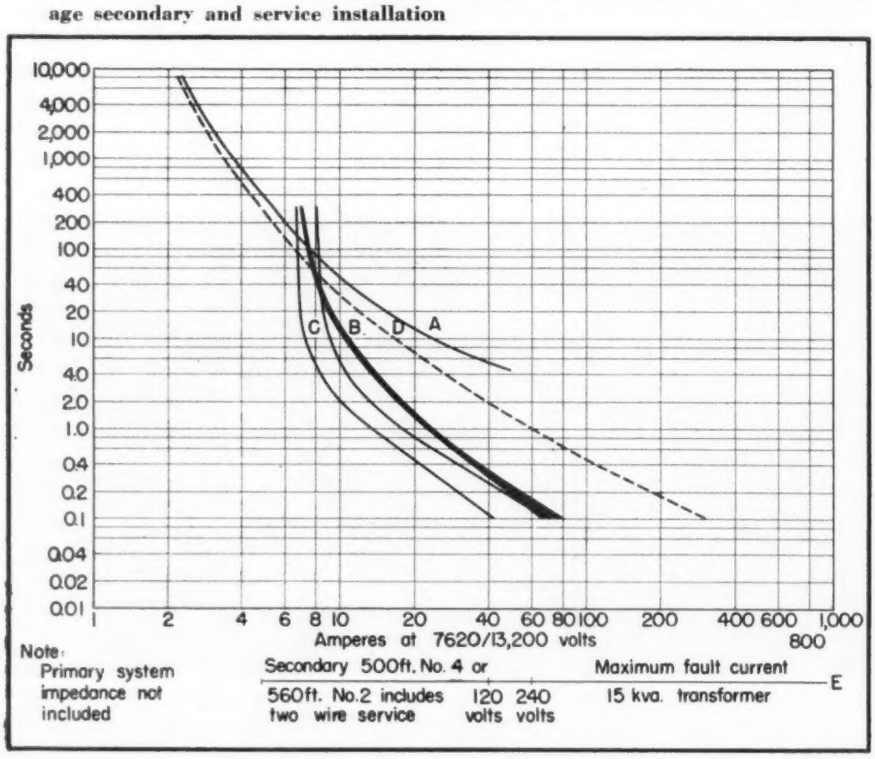
L. L. STAHLER, *Engineer, Florida Power & Light Co., Miami*

Thousands of dollars lost annually in unrealized short-time overload capacities, blown fuses and service impairment because ideal fuse is lacking—It should simulate the known time-current characteristics of transformers

PRIMARY FUSE LINKS were originally developed as a means of protecting distribution transformers. This is still the predominant purpose for which primary fuses are used. Early primary fuses consisted of lead wire of various sizes which was supplied on wooden spools, each spool being marked 5 amp., 10 amp., etc.

At that time no one was concerned, and probably few people knew anything concerning the time-current characteristics of transformers. Distribution systems were usually small and lightly loaded. Motors were small and starting currents presented no particular problem. Transformer fuses were lost frequently from lightning and if larger fuses were used, transformers were sometimes destroyed by shorted secondaries. This was the general condition 20 years ago, and very little improvement has been made since. The primary fuse remains as a device whose main use is to protect transformers from damage through overload of either long or short duration.

FIG. 1—Comparison of transformer and fuse-link time-current characteristics
A. Safe loading curve of 15-kva., 7,620–120/240-volt transformer
B. Melting and clearing curve of 5-amp., Line Material Co., "Ful-Slow" fuse link
C. Melting and clearing curve of 5-amp. Kearney QA-2U fuse
D. Ideal transformer fuse rated 15 kva., 7,620 volts with 100/0.1-sec. current ratio of 43:1
E. Fault current curve of 15-kva., 7,620–120/240-volt transformer including average secondary and service installation



Overload Capabilities

The time-current limitations of transformers are now well known, having been determined by the manufacturers and given wide distribution by them. Data contained in General Electric Co. publication GET-1008 under the title of "Short-time Loading Curves for Distribution Transformers 15,000 volts or less, 100 kva. and below," indicate that the ordinary distribution transformer is a rugged device which will safely carry great overloads for short periods of time. From these data it is found that the safe load on transformers is:

For 4 sec.....	25 times rated capacity
For 8 sec.....	15 times rated capacity
For 14 sec.....	10 times rated capacity
For 20 sec.....	8.5 times rated capacity
For 36 sec.....	6.0 times rated capacity
For 90 sec.....	4.0 times rated capacity

While a transformer has this inherent capacity, only a small part of it can be utilized. In order to utilize this capacity to the fullest extent, it is necessary to incorporate a protective device which will deenergize the transformer whenever the load on the transformer, expressed in time-current, approaches the safe loading curve.

* Paper presented by P. J. Carlin, Supt. of Distribution, at recent Raleigh meeting of engineering and operation section, Southeastern Electric Exchange.

It is the function of the transformer fuse to protect the transformer, but unfortunately there is no primary fuse available today which will do so. The melting and clearing time-current curves of a number of fuse lines have been investigated. The time-current curves of a fuse are accurately described by the ratio of clearing current at 100 sec. to the clearing current at 0.10 sec. These ratios were determined from clearing-time curves published by six manufacturers of fuses.

The fuses investigated and the ratios for the 100-amp. link are as follows:

MANUFACTURER	FUSE DESIGNATION	100/0.1-SEC. RATIO
General Electric	Universal Cable Type	7.05
Westinghouse Electric	Universal Type UT	9.37
Schweitzer & Conrad	Universal 64000	9.53
J. R. Kearney Corp.	QA-2T and QA-2U	10.90
Southern States Equipt.	Type F and AF	19.60
Line Material	Ful-Slow	22.70

The time-current curves (Fig. 1) of all of these fuse links are much steeper than the safe loading curve of a distribution transformer.

Curve E at the bottom of Fig. 1 shows the fault currents which can be developed through a 15-kva., 7,620-120/240-volt transformer assuming no primary system impedance. Fault current values are shown at the transformer secondary bushings for both 240- and 120-volt faults. Fault current values are also shown on an average length and size of secondary served from a 15-kva. transformer. The secondary fault is calculated on 120 volts and includes a two-wire service.

Limitations Apparent

The weakness of the two links shown is quite apparent. With a 40-amp. surge or fault, the links will clear in 0.25 sec. (Curve C) and in 0.35 sec. (Curve B). The transformer can safely carry 40 amp. for 7.50 sec. The thermal capacity of the transformer at 40 amp. is then approximately 2,100 percent greater than that of the slower 5-amp. fuse link.

With a load or fault equal to 7.5 amp., approximately four times rated capacity of a 15-kva. transformer, the safe loading curve of the transformer is reached at 100 sec. Under this load, both fuse links (Curves B and C) will have melted but will not necessarily have cleared and the transformer will probably have been damaged.

A load or fault ranging between 3 and 6 amp. would eventually destroy the 15-kva. transformer (Curve A), but would never melt either 5-amp. fuse link (Curve B or C).

New Line of Fuses Needed

Before a distribution transformer can be utilized safely throughout its time-current capacity range, an entirely new line of primary fuses must be developed. The approximate clearing time-current curve of an ideal transformer fuse link is shown on Curve D. This ideal fuse might be rated 15 kva., 7.6 kv., and would afford complete transformer protection, under all possible surge, fault or load conditions.

The number of fuses in any one line of links would increase only slightly as it would not be necessary to produce a link for each transformer in every voltage classification. The ideal link, Curve D, would protect not only a 15-kva., 7.6-kv. transformer, but several other transformers as well.

This one fuse might carry the following ratings:

25 kva.	13.2 kv.
15 "	7.6 "
15 "	6.9 "
5 "	2.4 "

And the degree of protection afforded to each type of transformer would vary only slightly.

Evolution Promising

Some fuse manufacturers have expressed doubt that such a fuse can be produced. Some seem to believe that their present line of fuses are impossible of improvement.

The recent development of the Ful-Slow line of fuse links by Line Material shows that improvement in a distribution fuse is possible.

General Electric Co., in their publication GEA-3255, show a line of alloy fuses for network transformers which parallel almost perfectly the safe loading curve of network transformers.

If a perfect coordinating fuse can be developed for network transformers, then surely one can be developed for distribution transformers.

Difficulty is encountered when attempting to coordinate primary fuses with relays and oil circuit breakers (Fig. 2).

The function of the instantaneous ground relay is to open the oil circuit breaker before a primary fuse can melt. That is, the instantaneous ground relay and breaker should protect the primary fuse under temporary faults. It follows that a primary fuse should have time-current characteristics which fall between Curve E and Curve D_1 for all possible values of fault current at the point where the fuse is installed. Curves F and F_1 show the transmission generating and substation impedance, expressed in fault amperes to the 13.8-kv. bus at location 1, and the 13.2-kv. primary impedance, expressed in fault current, at location 2. Curve F shows current values under 3-phase faults and Curve F_1 the current values under phase-to-ground faults.

Protection on a Lateral

The first fused lateral beyond the 13.8-kv. bus is at location 2. The fault current on this single-phase lateral can vary up to a maximum of 800 amp.

To be able to protect a fuse on this lateral under temporary faults, by the operation of the oil circuit breaker and instantaneous ground relay, the fuse must have a time-current curve, *both melting and clearing*, which falls within the area between Curve D_1 and Curve E at all reasonable current values below 800 amp.

Curve H is the time-current curve, melting and clearing, of a 100-amp. Kearney QA-2U fuse link. This fuse link has a 100/0.10-sec. clearing current ratio of 10.90. It is obvious that the instantaneous relay and 18-cycle breaker are too slow to protect this fuse when installed at Location 2.

Curve G is the time-current curve, melting and clearing, of a 100-amp. Line Material Ful-Slow fuse link. This fuse link has a 100/0.10-sec. clearing current ratio of 22.70. This fuse may be installed at Location 2 with the knowledge that it can be protected under all the possible values of fault current.

Further study of Fig. 2 will indicate

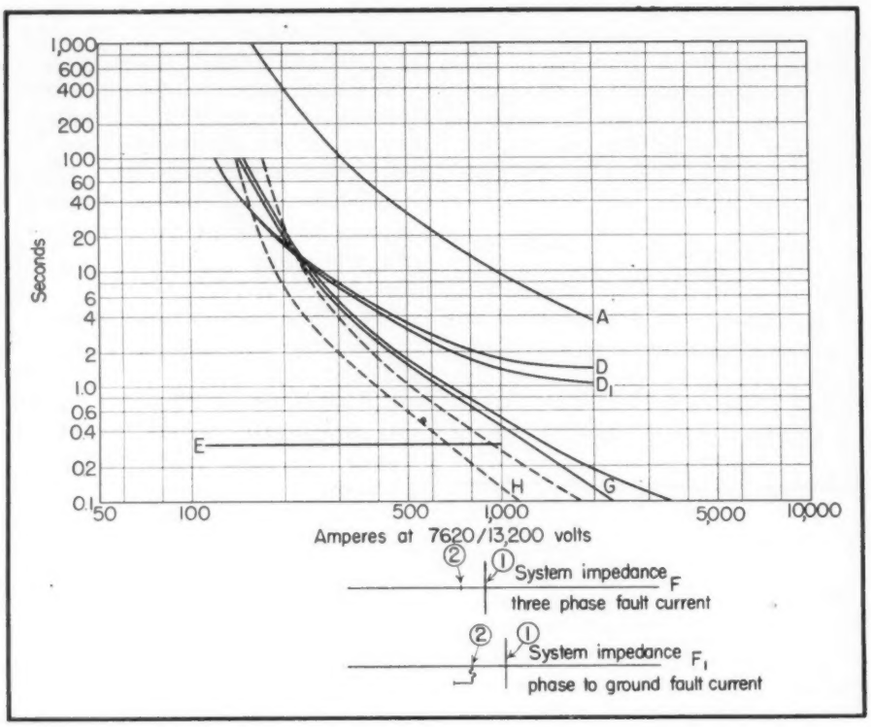


FIG. 2—Coordination of protected distribution fuses with relay and oil circuit breaker

A. Safe loading curve of 2,000-kva. transformer

D. Very inverse relay and breaker operating curve

D_1. Very inverse relay operating curve

E. Breaker clearing time, 18 cycles

F. System impedance three-phase fault current curve

F. System impedance single-phase-to-ground fault current curve

G. Melting and clearing time-current curve of Line Material "Ful-Slow" 100-amp. fuse link

H. Melting and clearing time-current curve of Kearney QA-2U 100-amp. fuse link.

Location 1—13.8-kv. substation bus

Location 2—Location of protected fuse nearest substation

that with larger substation capacity and consequent lower impedance, fault current values at Location 2 would increase. Under such conditions the 100-amp. Ful-Slow fuse link with a 100/0.10-sec. clearing current ratio of 22.70 could not be protected at Location 2.

Modification Indicated

The conclusion is inescapable that for proper coordination a fuse is required which parallels the operating curve of a very inverse relay and the safe loading curve of the substation transformer.

That is, a fuse is required which has a 100/0.10-sec. clearing current ratio of approximately 40:1. The ideal transformer fuse is shown on Fig. 1.

Annual savings which could be realized by power companies were such an ideal fuse to be made available are almost beyond belief. These savings would consist in greater utilization of transformer capacity under short time loads, decrease in, if not elimination of, transformer losses from faulted secondaries, reduction in number of transformer fuses blown from surges or motor starting currents and, finally, improvement in service continuity on the entire primary system.

All of these objectives can be realized when a fuse is developed whose time-current curve coincides with that of the device which the fuse is supposed to protect, a transformer.

A transformer fuse is a small thing, costing only 30 cents each, but its lack of correct design costs the industry tens of thousands of dollars annually.

• • •

Buoyant Cables Detonated Mines

Among measures devised by the British to counteract the German magnetic mines were the "degaussing" girdles on the ships, Wellington types of low-flying aircraft carrying large metal loops and, finally, buoyant cables towed over the mined area in an energized condition.

Orginally the cables were made buoyant by crude floats as described in a recent issue of the *Electrical Review*. The double-L sweep proved to be an effective means of creating a sufficiently powerful magnetic field to detonate the mines behind the minesweepers, themselves equipped with degaussing belts. Surges of several thousand amperes were discharged into the cables with the sea water between the ships as the return path.

W. T. Henley's Telegraph Works Co., Ltd. finished the first length of an improved design for delivery on January 10, 1940. Cylindrical "tennis balls" constituted the core and provided the buoyancy. The problem was to render the cable floatable and flexible despite the comparatively large cross-section needed to carry the momentarily heavy currents; outside diameter is approximately 3½ in. Over 3,000,000 ft. were built by Henley's and by Callendar's in various lengths to meet the needs of fleet minesweepers, trawlers and drifters.

In another design to meet a later emergency the buoyancy was obtained simply by stranding the conductor on a fairly large diameter steel spiral having plugs inserted at intervals so that the cable does not become completely flooded in the event of damage to the external sheath.

In addition to the foregoing, a third form of flotation was devised for another purpose last year and this involved the use of cork cylinders and expanded rubber.

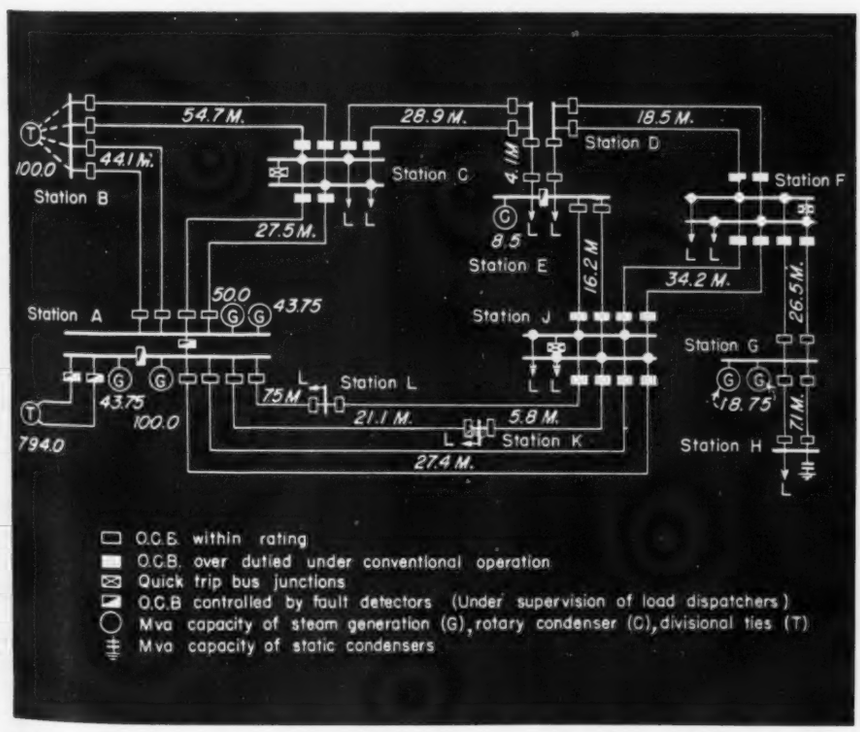
Quick-Trip Bus Ties Reduce Breaker Duties

Bus junctions at strategic stations in ring arranged for quick separation on fault—Instantaneous relays operate at 80 percent of limiting breaker capacity

ADDITIONS to system generation or transmission facilities inevitably lead to heavier breaker duties. To meet these increases on one system, general procedure has been to: (a) purchase new or modernize old breakers at high capacity stations; (b) re-locate breakers released in (a), modernize existing breakers, or exchange breakers at intermediate and law capacity stations. The last major system addition on an East Coast utility, however, came at such a time and involved so many breakers that past practices were modified in favor of the scheme described below.

The section of the system which was most vulnerable, from the standpoint of breaker duties, when 150 mva. of new steam generation was added at Station A and new circuits built from Station A to Stations C and J, respectively, is shown in the illustration. After much study it was decided to meet breaker requirements at all stations in the customary manner except at stations C, F, and J. This decision was based on the fact that fault duties of practically all breakers at these three stations would fall within rated capacity so long as the bus junction was open and all "black" and "white" circuits were connected to their respective "black" and "white" buses.

To put this plan into operation minor exchanges of breakers were made and eight-cycle bus junctions installed at Stations C, F, and J. Breakers at Station C and Station F are modernized ten-cycle types but are deficient in interrupting capacity. Breakers at Station J are not only deficient in interrupting capacity but have fault clearing speeds in the order of 18 cycles.



BREAKER LIMITATIONS in loop section relieved by bus splitting

Distance and OC Relays

Three zone distance phase relays and very inverse induction over current ground relays protect each circuit. Where split bus is possible, an independent voltage supply is provided for each bus. While it was possible to predicate tripping of the bus junctions on first zone relay operation (interphase faults being more severe than ground faults), the scheme adopted employed instantaneous relays connected in each current transformer circuit. These relays are set to operate on 80 percent of the breaker's rated interrupting capacity. Saturating characteristics of each current transformer were carefully checked at high currents. Bus junction breakers are equipped with one-shot automatic reclosers. Bus differential protection is provided for ground faults only.

Inherent Sectionalization

Station A is a natural system sectionalizing point. The two bus junctions, as well as the two divisional tie breakers here, are equipped with directional fault detectors. The bus tie breaker at Station E is equipped with a non-directional fault detector and is normally maintained automatic. The fault detectors are essentially distance relays and serve a twofold purpose. First, they can be set up so as to sectionalize the system automatically during unusual fault conditions in a prearranged manner. Second, they can be used to supplement the split bus scheme whenever single bus operation becomes imperative. "Set-up" of fault detectors is under jurisdiction of the load dispatchers.

The split bus scheme has been in service for four years and its operating record is considered entirely satisfactory. During this time a total of 6, 0 and 3 separations have occurred at Stations C, F, and J, respectively. The small number of operations is explained by the fact that: (a) to over-duty the weak breakers, 3-phase faults must occur within twelve miles of the bus considered, under maximum generating conditions; (b) approximately 80 percent of line faults in this section are single-phase to ground; (c) with standby Station G off, split bus at Station F is not necessary.

DIGESTS

Condensations and abstracts of articles in the foreign press, committee reports, unpublished papers before numerous technical societies, research bulletins, standards

Economics of Steel Tower Design

From a paper by P. J. Ryle before the Institution of Electrical Engineers (British), London, January 9, 1946.

DERIVED PARTLY from theoretical considerations, but largely from an analysis of existing designs, the weight of a steel tower above the ground line can be represented by the expression $kH\sqrt{M}$ (long) tons, where H is the over-all tower height in feet above ground, M is the overturning moment at the ground line in thousands of lb.-ft., and k is an empirical constant which has values from about 0.0014 to 0.0029 for a large number of towers investigated. The range covered was about 16 to 1 in height, 3,000 to 1 in overturning moment, and 1,200 to 1 in tower weight.

The economic value for the base width of any tower is approximately $0.5\sqrt{M}$ ft. On the assumption that for any given type of tower the total erected cost may be regarded as proportional to the above-ground weight, the above tower weight formula can be used with convenience and reasonable accuracy for a wide field of cost investigations, especially those involving comparisons of a number of alternatives of generally similar nature.

Coal-Fired Turbine Planned

From "Bituminous Coal Research," October-December, 1945.

COAL AS FUEL for a gas turbine is proposed in a report to *Bituminous Coal Research* by J. I. Yellott, director of research of the locomotive development committee. Raw coal is to be conveyed from the locomotive tender by a screw to a small crusher which will reduce it to minus-ten mesh size. The crushed coal is then transferred pneumatically to alternate hoppers where it is kept under gas pressure until needed. Then it will be conveyed, again by air, to a "coal atomizer," where by expansion under steam or air pressure through a nozzle it will be reduced to about 55 percent through 200 mesh.

The pulverized coal will be burned under 60 lb. pressure in a vortex combustion chamber, centrifugal force aiding rapid combustion and permitting recovery of part of the ash. The exit gases, at a temperature of about 1,200 deg. F., will be cleaned centrifugally of all but the smallest ash particles and expanded in a gas turbine.

Experimental work is now proceeding at the Battelle Memorial Institute, Johns Hopkins University, and the Institute of Gas Technology.

Stresses in Pole Dovetails

From an article by H. Zschokke in "Brown Boveri Review," June, 1945.

STRESSES in the dovetail pole joints of the rotors of large waterwheel generators may reach excessive values on overspeed tests. As a test run on a certain machine required 2.8 times normal speed, preliminary investigations were made to determine the safety of the structure.

Experiments conducted with celluloid models showed that in the corners of the joints stresses of the order of 59 kg. per sq.mm. (108,000 psi.) were reached, thus greatly exceeding the yield point. Since this result was based on material acting with perfect elasticity, further tests were conducted on cast-steel models. These proved that a well marked yield point exists when the pole begins moving outward, at a value 62 percent higher than the tensile load on the poles during the test run.

A brittle varnish coating on the model indicated the position and character of the deformations by cracking. Even well beyond the yield point the material behaved more or less elastically. When the pole was entirely pulled out there was no cracking of the material.

Determination of Fusing Current

From an article by G. W. Stubbings in "The Electrician," London, January 25, 1946.

EXPERIMENT and actual experience do not bear out the well-known Preece formula for fusing current, $I = a\,d^{3/2}$, where d is the diameter of the wire and a is a constant depending on the material. It is apparent that the assumption that all the heat produced is dissipated by radiation is erroneous.

In short fuses considerable dissipation of heat takes place through conduction to the terminals, and in all fuses except those surrounded by a heat-insulating material convection removes considerable heat. The relations are complicated, as the rate of dissipation per degree of temperature rise depends not only on the wire surface but also on the velocity of the cooling medium, its thermal conductivity, and the heat capacity per unit volume.

An analytical discussion shows that for fixed characteristics of the cooling medium the rate of heat dissipation by convection is proportional to $d^{\frac{1}{2}}$, and the fusing current is proportional to $d^{3/4}$. From theoretical considerations the index of d in a fusing current formula can vary between 5/4 and 2; the more heat dissipated by convection the lower the index. No single formula can give the sizes of wires of given material for various fusing currents for fuses and fuse links of all types. The Preece formula is considered so untrustworthy that it should not be quoted without some statement of its limitations.

Vibration Problems Analyzed

From a paper by A. J. King before the Institution of Electrical Engineers (British).

VIBRATION manifests itself as noise, physical discomfort, or possible failure of a part due to elastic fatigue. Its measurement may be absolute as compared with a stationary point in space, or relative, as between two members of the same mechanism. An accelerometer may be used

for absolute measurement, a body of known mass being made to execute a fraction of the vibration to be measured. Several other mechanical methods are available.

Electrical methods of measuring vibration depend on a detector which transforms vibrations into electric currents or voltages. A very sensitive method is to measure electrically the acceleration of a pair of quartz crystals, co-phased. Amplifiers may be used to facilitate readings. Calibration of measuring apparatus may be made by vibrating tables, driven mechanically or electrically.

Suppression of vibration may be accomplished by reduction at the source, by resilient mountings, and by increased mass. The method to be used will depend on the type of vibration. Success in reducing the effects of vibration with resilient mountings depends on the accuracy of the computations.

The author has devised apparatus for obtaining data on the dynamic properties of materials in simple direct compression. Improvements have been made in an earlier device to employ mechanical resonance with a moving coil drive. This is capable of giving useful information on the static and dynamic elastic properties of materials suitable for resilient supports. Thus far a few typical resilient materials have been tested, but many more tests will have to be carried out on different samples to obtain representative data.

Electric Drive In Flour Mill

From an article in "The Electrician," London, January 18, 1946.

ELECTRIC DRIVE throughout was installed in a large British flour mill so as to increase the output greatly to meet war conditions. In order to obtain a high power factor, the principal group of machines for "breaking down and dressing" is driven by a 175-hp. motor of "no-lag" type. The unit resembles an induction motor, but the secondary winding is in the stator and the primary, along with a compensating winding in series with it to vary the angle of lag as required, and a commutator, is on the rotor. Starting is effected with liquid resistance in the secondary winding.

In five years of service the plant has run 35,655 hr.; in 1942 it worked 159 hr. per week out of a possible 168 hr. The load was 171 kw., giving a load factor of 75 percent. Power factor was maintained at 0.978, and the extra cost of the special motor was recovered in the first twelve months.

Electrodeposition of Nickel-Cobalt Alloys

From a paper by C. B. F. Young and Clifford Struyk before the Electrochemical Society, Birmingham, Ala., April 10-15, 1946.

BRIGHT or semi-bright nickel-cobalt alloys can be electro-deposited from a chloride solution with current densities of 15 to 50 amp. per sq.ft. at room temperature. Cathode current efficiency is high with a pure solution. The deposits are smooth, ductile, fine-grained and easily buffed. Superposition of alternating current on the direct current was found to give little or no advantage.

The principal value of the method is as a base for bright chromium plating which is superior to the ordinary nickel base. The nickel-cobalt plate is whiter, harder, and more corrosion resistant than nickel alone. Little or no buffing is needed before the plating of bright chromium deposits on the nickel-cobalt alloy.

Integrating Meter for Measuring Nuclear Radiation

From an article by C. G. Montgomery and D. D. Montgomery in the "Journal of the Franklin Institute," January, 1946.

PROTECTION of workers from effects of high-energy radiations involved in the many nuclear transmutations in progress at the present time prompted the design of a rugged, inexpensive radiation meter, intended to integrate radiation intensity over an entire working day.

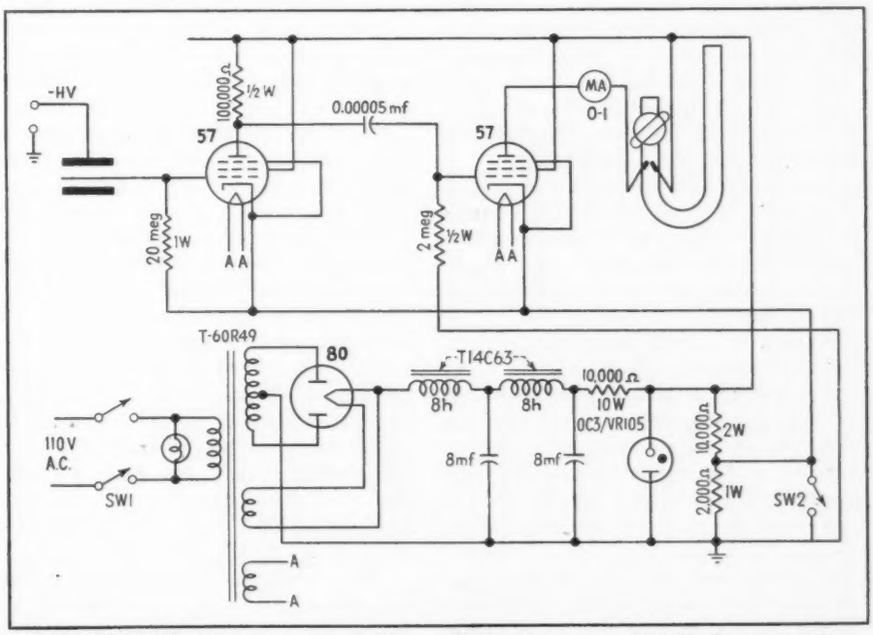
The amount of exposure, which is measured with a Geiger-Muller counter, and which is proportional to the total number of counts recorded, is determined from the quantity of gas evolved in a simple electrolytic cell, the current through which is controlled by the counter.

The counter, which was described in three articles by the same authors in the *Journal of the Franklin Institute* for 1941, gives a negative voltage impulse which cuts off the plate current of a vacuum tube for a time depending on the magnitude of the impulse. The positive voltage from the first tube plate is fed through a small-time-constant circuit, and turns on a second tube for a time independent of the size of the counter pulse. The plate current of the second tube flows through the electrolytic cell, where a given amount of gas is released for each counter impulse. The meter in the plate circuit thus indicates a current proportional to the counting rate, while the amount of gas released is proportional to the total number of counts.

Electrifying Miners' Homes

From an article by C. R. Taylor in "Electrical Review," London, January 25, 1946.

REPLACEMENT of coal for homes of British miners with electricity is seen as a distinct economic possibility. A power plant at the pit mouth burning the same coal now supplied to the miners at cost,



THE AMOUNT of exposure to nuclear radiation is measured daily for protection of workers by a Geiger-Muller counter

and which has a heat value of 12,500 B.t.u. per lb., should produce 10,000 kw.-hr. from the 9 tons used in a year on the average, and deliver 8,000 kw.-hr. to the consumer. Burned in domestic grates, it would produce about 12,500 kw.-hr. of effective energy. However, the more efficient use of electricity would bring the "ration" well above the average for houses on fully electrified estates, which were stated as 4,000 to 5,000 kw.-hr. by a recent I.E.E. speaker.

Moreover, poor quality fines could be burned in a generating plant at the pit mouth. Probably 7 tons of this would replace 9 tons of good domestic fuel which could be sold at the full market price. The local utility could handle the business and gain an advantage from the increase in load. If only 0.1 d. (0.2 c.) per kw.-hr. were added to the pithead price of energy, the annual revenue would amount to £2 to £4 ($8 to $16) per house, or considerably in excess of the cost of distribution. Elimination of smoke, saving in collection of ashes, and saving in cost of construction of new houses, are incidental items that would go far to meet the cost of electrification.

Requirements of Precision Capacitors

From a paper by C. G. Garton before the Institution of Electrical Engineers (British).

INCREASED USE of capacitors and dielectrics and products made from them has created a demand for more accurate capacitors as standards. The permanence of mica capacitors under normal conditions of storage is roughly of an order of magnitude less than would be desirable for some purposes. Their loss angle, with adverse humidity, may not be permanent. Improvement may be sought by development of evaporated metal electrodes and use of air-tight sealing.

Loss angle of most existing air capacitors, which is appreciable at low frequencies, may be improved by interception of insulation and a better choice of electrode material. Only the more elaborate types have a capacitance stability better than one part in 10,000 over long periods, and improvement is desirable.

Many existing data on dielectrics used in precision capacitors are of doubtful accuracy due to small experimental errors of which the existence has only gradually been realized. Notably the loss angle and temperature coefficients of expansion and dielectric constant of mica are all uncertain except as regards order of magnitude. In particular, attention is called to an apparently unrealized source of error in loss-angle measurements on samples with a guard ring.

Final Steam Temperature Control

From an article in "Heat Engineering," New York, July-December, 1945.

HIGHER STEAM PRESSURE and the demand for highest operating efficiency have dictated the use of maximum steam temperatures, and their precise control has become a factor of prime importance. A steady final steam temperature over wide load ranges without the compromises involved with a convection superheater can be obtained only by combination of a convection and a radiant superheater operating in series. With increase in load the steam temperature from the former rises and that from the latter drops. By properly proportioning the surfaces of the two, a surprisingly constant steam temperature can be obtained over a wide load range. Variations in the temperature may be created by changes in the feed water temperature and in CO_2. Still wider load ranges at fixed steam temperature are available for large units through the use of the recent "twin furnace" boiler design.

Load ranges of about 6 to 1 at final steam temperatures of 910 to 950 deg. F. have been maintained through extreme ranges of temperature control, regardless of the fuel quality or variation of excess air and feedwater temperature.

Plunger Voltage Regulator

From an article by A. Meyerhans in "Brown Boveri Review," June, 1945.

VOLTAGE REGULATORS of the plunger type have been developed by Brown Boveri to provide constant voltage on long supply lines, as tapped autotransformers are too expensive for small outputs. There is an absence of moving contacts in the main circuit, as with tap-changing devices.

A primary coil connected across the supply is inclosed in a laminated steel shell. Inside it is a secondary winding which is free to move axially in an annular gap in the core. The plunger coil is wound on a bakelized paper cylinder attached to a spider which moves on a threaded spindle, and is rotated by a small control motor. When the coil is within the primary coil, full voltage is generated, but as it is withdrawn the induced voltage is reduced gradually, reaching a value of zero when entirely outside the core. By having a high upper yoke in the magnetic circuit, the magnetizing current is not excessive.

The moving coil is connected as the secondary of an autotransformer, and with the standard design, a range of 20 percent in the supply voltage is possible. The coil can be used to boost or buck through the use of a small auxiliary winding. For three-phase circuits an assembly of three units is made. The entire device is assembled in an oil-filled tank, and the small sizes are light enough for pole mounting.

Carbon Resistor Furnace

From a paper by W. J. Kroll, A. W. Schlechten and L. A. Yerkes before the Electrochemical Society, Birmingham, Ala., April 10-13, 1946.

DEVELOPMENT of a new design has largely overcome disadvantages that caused virtual abandonment of the carbon resistor furnace with the advent of the high-frequency furnace. The heating element is a graphite cylinder which makes its contacts at the bottom with split water-cooled copper clamps. The cylinder is split part way up the side, so that the current goes up one side and down the other. In this arrangement the resistance is almost four times that of a similar tube with top and bottom clamps, and the graphite is free to expand and contract.

The construction is rugged and compact, and the heating tube can be replaced with little trouble. By making three or six splits in the tube, the furnace may be supplied by 3-phase or 6-phase current. Despite certain drawbacks the performance is quite satisfactory.

Efficiency of the graphite resistance is said to be about 38.3 percent as compared with 33.7 percent for a high-frequency furnace. For certain purposes the graphite resistance furnace is to be preferred, being lower in original cost and easier to run and to maintain.

Current Transformer Errors Circulated

From a paper by G. F. Freeman in the "Journal of the Institution of Electrical Engineers," (British) November, 1945.

OVER the normal working range of a ring-core current transformer, the watts and volt-amperes vary with the nth power of the flux density. The active component of the percentage error, E_a, and the reactive component, E_r, may be expressed by the formulas:

$$E_a = C_a \times (l_e/SI)^{n_a} \times (VI/W)^{n_a-1}$$
$$E_r = C_r \times (l_e/SI)^{n_r} \times (VI/W)^{n_r-1}$$

in which l_e is the length (cm.) of the mean flux path in the core, SI the ampere-turns, VI the total burden, and W the weight (kg.) of the core. The empirical constants are, for Stalloy, $n_a = 1.7$, $n_r = 1.6$, $C_a = 25$, $C_r = 50$; for Mumetal, $n_a = 2.0$, $n_r = 1.7$, $C_a = 10$, $C_r = 10$. To avoid evaluating the formula, charts

may be prepared for rapid calculation.

With an inductive burden having a lag angle ϕ and with turn compensation of T percent, the ratio error is sensibly $[T - (E_s \cos \phi + E_r \sin \phi)]$ percent, and the phase error 34.4 $(E_r \cos \phi - E_s \sin \phi)$ minutes.

Assumption of uniform flux density in the cross section of the ring introduces no serious error. An inverse correction factor F for the error components is derived. For a ring of average dimensions F is shown to be 1.06, so that the true error is 6 percent less than that calculated on the assumption of uniform density.

Distribution Plans For Future Loads

From a paper by Chase Hutchinson before the Southeastern Electric Exchange, Birmingham, Ala.

LOAD FORECASTS for an urban distribution system should be for ten or more years, or cover a growth of some 50 percent. To avoid pitfalls from failure to meet the forecast, periodical review is needed; changes in timing of planned construction must follow deviations of growth rate. Next is a breakdown into substation and feeder loads, either in direct proportion to present loads or in conformity with local judgment and knowledge.

Planning of primary distribution requires basic data on loads and power factors of feeders and substations, as well as ratings and capability of the various system components. Substations and feeders should be planned for possible changes in arrangement in the event of abnormal growth. Two maps showing lines and locations of apparatus at intervals of five and ten years are needed.

Probably fairly large areas cannot be served in future by existing facilities. Schemes for detailed investigation may well fill these general principles:

1. Losses should be figured from the demand component and the energy component, the former usually being much greater.

2. Direct distribution at 12 kv. usually shows economy of initial investment and continuing cost.

3. Comparatively long feeders are indicated where a distribution substation can be supplied directly at generator voltage, due to elimination of transformation.

4. Retention of distribution at 4 kv. may be better than to incur the initial expense of a change to 12 kv.

5. As relatively few tripouts occur on a 44-kv. to 132-kv. ring system, substations of 3,000 to 6,000 kva. may be tapped to it without additional high-voltage circuit breakers.

6. With a firm transmission supply, outlying substations on 12- or 13-kv. lines can provide radial load of roughly twice their tie-line ability.

7. With growing load there is little justification for continued use of 2,300-volt distribution.

Good 4-kv. equipment that is removed should be used promptly elsewhere when a change to 12 kv. is made. In using these principles increasing labor cost and a distinct tendency toward simpler and cheaper substations must be considered.

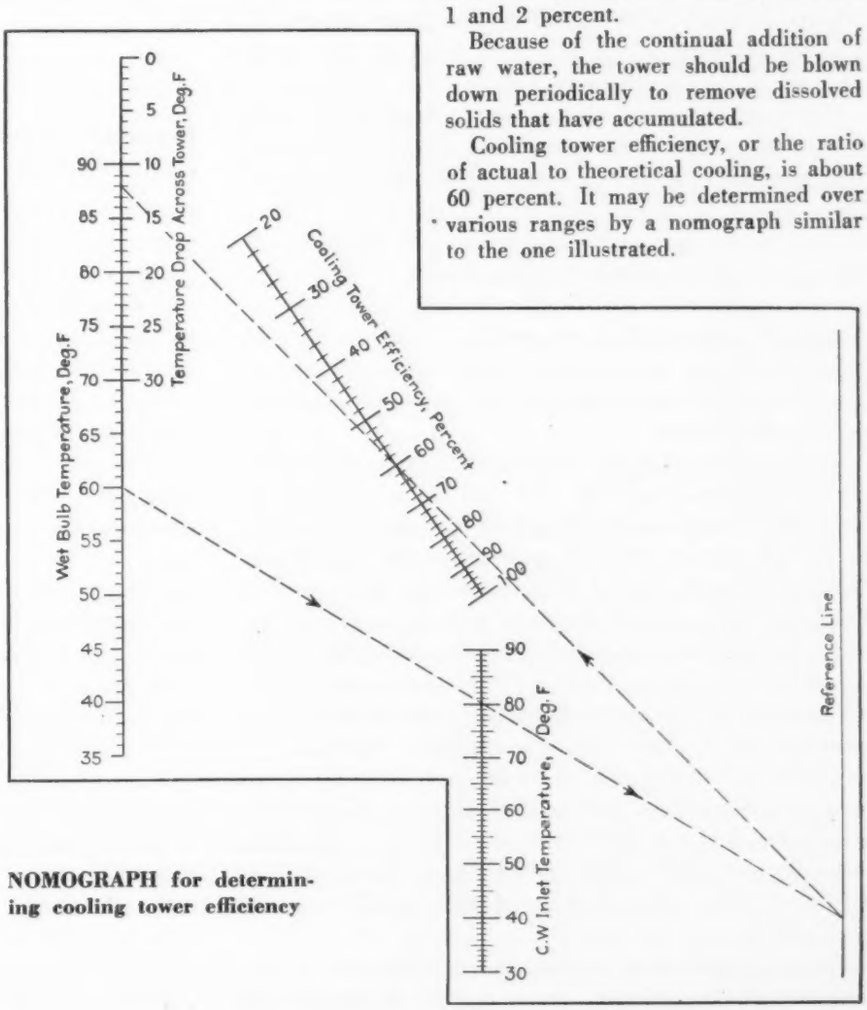
In evaluating future plans several conflicting factors must be considered.

1. With growing load reduction in future loss demand is equivalent to saving future system capacity.

2. Reduction in operating expenses may not show in full as net saving because of taxes, but may offset a future rate reduction.

3. Since prediction of load growth and costs may be inexact, a comparatively high rate of return on the proposed investment should be required.

New developments in basic items may completely change the solution. Pole-type capacitors, aerial cables, and higher operating temperatures are instances.



NOMOGRAPH for determining cooling tower efficiency

Efficiency of Cooling Towers

From an article by G. Oldroyd in "Electrical Review," London, December 21, 1945.

FERRO-CONCRETE cooling towers have been designed to handle as much circulating water as 5,000,000 gal. per hr. with a temperature drop across the tower of 8 to 20 deg. F. Water is sprayed onto a set of wooden louvres, forming a fine shower which drops into a pond at the tower base for re-use. Reduction in temperature is due in part to heat transfer to the circulating air, and in part to absorption of latent heat of vaporizing some of the water.

In England about 80 percent of the cooling is by evaporation. With low humidity the ability of the air to absorb water is high, so that the efficiency is greatest on warm dry days.

Evaporization necessitates a supply of make-up water, the amount of which may be estimated as $(q' - q)/E$, where q lb. of water vapor per cu.ft. are in the entering air, q' lb. per cu.ft. are in the air as it leaves, and E pounds of water are cooled. The amount is usually between 1 and 2 percent.

Because of the continual addition of raw water, the tower should be blown down periodically to remove dissolved solids that have accumulated.

Cooling tower efficiency, or the ratio of actual to theoretical cooling, is about 60 percent. It may be determined over various ranges by a nomograph similar to the one illustrated.

EDITORIALS

S. B. WILLIAMS, *Editor*

Coordination of Lighting Efforts Needed

IF the enthusiasm and interest shown at the first International Lighting Exposition in Chicago last week can be sustained, and there is no reason why not, lighting will be big business in this country for several years. It wasn't the thousands who saw the exhibits that encourage the industry so much as the hundreds who jammed every bit of available space at the forums to learn all they could about the plans for relighting America.

From every section of the country and from many other places people came to see what was new in lighting equipment and to learn how to tackle the relighting market. There wasn't much that was excitingly new in lighting design to show them, nor will there be until the materials and parts situation clears up considerably. There was, however, much that was new in the way of promotion. People who attended the show went away with the thought that the public interest was due for a tremendous stimulation and that the industry had to move fast to prepare itself to serve this demand.

Because the market for relighting is not something that can be cultivated leisurely, but will be on us like an avalanche, there is no one element in the industry that can do the job alone. Orderly procedures for installation, distribution, sales, layout and production are essential. Thousands of people who formerly paid little or no attention to lighting must be trained in its fundamentals. Shall this be done systematically or on a catch-as-catch-can basis?

Education in lighting fundamentals, sales training, programmed promotion—all need centralized direction and coordination. In the past one or two lamp manufacturers have provided a large part of this direction and coordination, but it is too much to expect them to continue to carry the ball alone. If this market is worth cultivating, it is worth the combined efforts of all who will share in the benefits.

For that reason it is becoming more and more evident that the lighting industry needs a trade association or organization of some kind that will undertake the job of directing the relighting of America. From the Illuminating Engineering Society will come the recommended practices which such a proposed organization can implement with marketing tools.

Just how such an organization might be set up and financed is something for the industry to decide. However it is done, it should be done soon because just as soon as fixture production has no more brakes on it we shall need a central directing agency if the best job is to be done.

By the time the equipment is once more in full supply there will be available for every major segment of our economy a new or revised I.E.S. lighting practice recommendation. These quasi-standards, some of which have ASA acceptance, represent the best attainable lighting reasonably available. Any installations that fall short of these standards deprive the industry of business and employment and the customer of the lighting which he thought he was buying. The proposed association could be given the responsibility for popularizing these recommended practices.

There are many other things to be done, too numerous to mention here, but just as necessary. An exploration group representative of all interested industry segments would seem advisable at this point to consider what might be done, how it might be done and by whom.

International High Voltage Conferences Again

QUICK on the heels of the retreating foe last summer came preparations for the resumption of the biennial sessions of the International Conference on Large Electric High Tension Systems, with the result that in less than a year after the surrender of the last enemy delegates will meet once more in Paris to hear papers and reports on interim studies.

Every other year since its founding in 1921, this conference met until prevented by war. The sessions the last week in June and the first week in July this year will be the first since 1939. While three sessions were lost during the war years, and there is much for the conference to consider this time, there was not the same progress abroad during that period. Nevertheless, 100 technical papers are scheduled for presentation at this year's sessions, which might be compared with 117 presented at the last conference.

As might be expected, American practice will come in for more discussion than at previous sessions, because the war stimulated transmission progress in this country.

Twice as many technical papers will be presented by American authors as in 1939.

While many of the papers from other countries will deal with problems that have already been met within the United States, the trends of equipment design abroad to meet the demand for larger and higher voltage systems will be of interest to American engineers.

Quite apart, however, from being able once more to

exchange technical information is the opportunity to recement international friendships, and to bring about some measure of understanding between peoples of the world. Today such understanding appears to have great difficulty thriving in the shadow of power politics, so that any way in which it can be cultivated is desirable.

Gang-Operated Disconnects

WHEN ALL DISCONNECTS were of the hook-stick type it was easy to afford thorough protection to the operator by means of a good stick, rubber gloves and a grounded rain shield. His body need not ever become a parallel path.

But the present generally used group-operated disconnecting switch involves different problems, especially the hazard of voltage gradients where the operator has to stand in proximity to the structure. A fault occurring at the time of operating the switch would almost certainly involve the operating mechanism as well as the structure and consequently the operator would be exposed to the difference of potential between the switch handle and ground, unless steps are taken to mitigate this hazard. Several measures are usually considered.

For one thing, the operating handle can be removed to a grounded stub column and an adequate insulator inserted in the vertical member of the operating mechanism; the insulator is futile, however, unless the structure in parallel is insulating or similarly insulated. An alternative is to leave the handle on the main structure and ground it separately by means of a heavy flexible cable; with this arrangement the operator's body experiences only the voltage drop over the grounding lead.

However, neither of these measures offers protection against the steep voltage gradient that may occur in the first few feet surrounding the ground connection when heavy fault current flows to ground. Theoretically the answer to this is, of course, a sufficiently large steel plate or grating so located that the operator has to stand on it with both feet when he is performing the operation; the platform must be solidly grounded to the structure and to the ground bus.

It appears practically, however, that the use of a platform supported on insulators of adequate voltage rating can better be relied on to prevent the operator's body becoming a parallel path to ground. So long as it is completely insulated it is immaterial whether the platform be of wood slats or of metal grating. The principal hazard, of course, is that the operator may touch the energized structure while one foot is still on the ground.

As for preference between the grounded and insulated platforms it seems that the insulated form has superior merits particularly where it is difficult to get ground bus resistances as low an one ohm (often the case at small stations) or where the fault current runs to high values, say in excess of 25,000 amperes.

Something New—
A Customer Opinion Survey on Strikes

IN our next issue, May 25, we shall present in ELECTRICAL WORLD the first customer opinion survey on strikes of electric utility workers. Instead of taking the public at random, we confined our survey to a balanced cross-section of customers in those areas where there had recently been a strike or threat of strike of utility workers. In that way we were able to interview people who had made up their minds.

In the same issue, the first ever to be devoted to the broad subject of relations with organized labor in the utility industry, we shall present a history of strikes to date, the first statistics on union membership in the industry, a summary of labor legislation affecting utilities and statistics on wage trends.

It is an issue which, we expect, will actually be of great interest now and will also serve as a reference number for some time.

Pushbutton Wiring System

FIRST appearance of a pushbutton and relay wiring system for lighting circuit control in a post-war demonstration house recently placed on display in Los Angeles suggests a possible new approach to selling adequate wiring in the home. For years leagues and bureaus have had their adequate wiring standards and sales promotions but the cash register has never been rung with a mass selling job. Perhaps this new "Pushbutton Wiring System" is the answer.

Every other industry involved in home building has something new and glamorous to offer and a sales program geared to get its share of the home builder's dollar. As far as wiring is concerned, in the Pushbutton Wiring System the electrical industry would have something really new to offer, too.

About one-third of the cost of wiring a house goes into switchloops. With low-voltage control wiring and relays that mount directly in standard outlet boxes, considerable savings appear possible—savings which could be diverted into more lighting controls and more convenience outlets with adequate circuiting and wire size. If we can give the home builder a bigger dollar value it ought to be easier to sell adequate wiring so that every branch of the electrical industry, including labor, ought to benefit.

The idea is not new; such a system was used in Denver 25 years ago, but it is new in practicability. The thing that has put it back strongly into the picture is the development of suitable small relays or contactors.

The Pacific Coast, which was a pioneer in adequate wiring promotion years ago, again offers something intriguing in its sales appeal.

WASHINGTON COMMENT

By R. N. LARKIN Washington Correspondent

Shadows Cast by Coming Events in Government Power

IN THE MINDS of many who are interested in the economy of the electric utility industry, the advances of public ownership during the war have aroused concern as to whether the die has not irretrievably been cast in favor of the ultimate extinction of private ownership of power.

Any such forebodings must be based on an established legislative principle which directs that preference in the sale of electric power generated at federally owned plants be extended successively to the federal government, states and their subdivisions, and nonprofit bodies and cooperatives. Thereafter, such power as remains may be sold to "other persons," namely, privately owned power systems. This principle was first enunciated in the Reclamation Act which became law during the first decade of this century and has been a provision ever since.

War-Time Legislation

As the United States staggered up to and then into war, federal activity in the electric power business boomed. Came the war and a hard-handed shutdown on a substantial portion of the sizable public power program then being pursued.

The war-time construction downhold, however, merely diverted the public power bloc's activities more completely to Capitol Hill, to which was taken a number of major objectives. Quick review of this legislative campaign brings to mind only one major objective which was not won—specific and unequivocal authorization of steam-electric plants to back up government hydro systems.

What public power did win on Capitol Hill was a most important integration of its marketing system, whereby the Interior Department now is responsible for the disposition of all electrical energy generated in federal plants except that developed by the Tennessee Valley Authority. This consolidation is not academic, for it means that Interior now markets Army power, and Army flood control and river improvement plans call for lots of power on streams within transmission distance of eastern and midwestern load centers.

In addition to winning its consolidation fight, public power won authorization for a phenomenal amount of new federal hydro capacity. So the resumption of construction finds the public power crowd with a lot of new plants authorized, with a Congress not visibly insistent on economy in public works, and with a mandate to sell the power preferentially. It seems apparent, moreover, that municipalities and "other persons" — utilities — will be the two most promising immediate customers for the bulk of this output. Rural electrification cooperatives will be good customers as well, but probably neither sufficiently numerous nor large to handle major amounts.

These are the considerations which lead some people to wonder if anything other than ultimate extinction awaits private power, for if enough rivers be dammed to provide enough kilowatt-hours which are transmitted to enough cities which can be persuaded to municipalize distribution systems, enough companies will have suffered enough impairment of their systems as to be forced to take what they can get for the suburban and rural portions which remain.

Generating Cost Not a Factor

One of the more persuasive arguments that federalization need not necessarily mean private extinction comes from one of Washington's staunchest public power men. He argues first that the difference in cost of generation at a federal hydro plant and at a modern, privately owned steam plant is presently insufficient to spell doom for private ownership.

That leaves the imposing matter of income taxes. In this regard, it is pointed out that the freedom from income taxes is implicit in all public ownership, not merely federal ownership. Thus, if the tax avoidance is sufficiently attractive to be a root cause of public ownership, such ownership should thrive irrespective of the source of energy.

To make the point, this public ownership man cites Portland General Electric, which has flourished in an area where public ownership is common, but where efforts to unseat it have been unavailing. He cites Cleveland, where the Electric Illuminating Co. has expanded while a modest municipal system remains modest; Milwaukee, where even a Socialist city administration could not get public ownership; and Madison, Wis., capitol of a state which has never hesitated to eschew political orthodoxy, but which has never accepted the numerous proffers of municipal ownership. He notes the continued existence of the Alabama and Georgia Power companies in the very shadow of TVA, and selling more and more energy at rates which compare favorably to those of TVA.

Cheap, Dependable Service

He thinks the answer lies in the job the company does at home in bringing its people cheap, dependable electric service.

The argument, too logical to be scorned, merits qualification. There may arise a tendency for municipalities to believe that federal generation will make municipal ownership a much easier tiger to ride. Also, the extent to which Interior people strive to advance municipalization will affect the issue, just as will attempts by private companies to retard it.

Unquestionably there will be some drift toward public ownership, but there is nothing yet to indicate that private ownership has lost the fight and should throw in the sponge. In fact, the private power people are probably stronger today on Capitol Hill than at any time since the beginning of the New Deal. It may be this very gaining in strength which is responsible for the greater activity on the part of the public power bloc that appears to give evidence of forthcoming gains in that direction.

NEWS OF THE WEEK

2 Federal Agencies Act To Keep Electricity Flowing

CPA Makes Mandatory Interchange of Power and Maximum Use of Fuels Other Than Coal—Office for Emergency Control Set UP—FPC Waives Jurisdiction Over Temporary Interconnections

ALARM over the effect of the coal strike and the resulting coal shortage on electric utilities brought results in Washington this week from two federal agencies, the Civilian Production Administration and the Federal Power Commission.

CPA issued order U-10 making mandatory the interchange of power and the maximum use of fuels other than coal. The FPC advised that such interconnections for the present emergency shall not affect the jurisdictional status of electric utilities under the Federal Power Act.

CPA has also organized an office for emergency control to handle problems arising out of curtailed fuel stocks of electric and gas utilities and has placed Edward Falck, former Office of War Utilities director, in charge.

Order U-10 reads as follows:

(A) Applicability of Order—This order shall apply to all electric utilities located in any state east of the Mississippi River or in Minnesota, Iowa or Missouri.

(B) Electric Utilities to Conserve Coal—Each electric utility shall so operate its reservoirs, generating plants, substations, transmission lines and other facilities, and shall so interchange power with other electric utilities as to achieve the maximum conservation of coal. Such operations shall, depending upon the supply and availability of fuels other than coal, include the following:

(1) Using water power to the fullest extent practicable to achieve conservation of coal.

(2) Using fuels other than coal to the maximum possible extent.

(3) Exchanging power with other electric utilities wherever such exchange will result in protection of low coal stockpiles.

(C) Electric utilities with less than 30 days' supply of coal may apply to the Civilian Production Administration for assistance in obtaining a portion of its electric power requirements from other utilities.

Over the signature of John D. Small, CPA administrator, the following letter was sent to the governors and state control commissions of the states of Connecticut, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, West Virginia, and Wisconsin:

"A survey completed yesterday by the Civilian Production Administration shows that coal stocks of electric utilities are reaching the danger point. You are strongly urged to set up curtailment programs for utilities in your state where necessary to ensure continuance of electric service for essential public health and safety requirements.

"Based on war-time experience in administering electric power controls we recommend that you consider issuing an order which would provide for curtailment in several stages as follows:

Early stage—Prohibition of use of electricity for advertising, display lighting, car heating, air conditioning, places of amusement, and progressive curtailment of commercial and industrial usage on a percentage or hours of use basis. Final stages—Prohibition against all uses except for public health, safety, hospitals, food processing and other essential community services.

"It will require about 14 days as an average to reestablish a steady flow of coal supply after the resumption of mining. We believe that curtailment in the early stages should begin when stocks will last for only 20 days at the final reduced rate of consumption. No fixed rule can be given as conditions vary widely depending on availability of water power and use of fuel other than bituminous coal.

"Please advise this office of orders issued by you during this emergency. Will support your program, and we are prepared to issue supplemental orders if required to do so by you."

FPC after studying the situation issued this statement on its finding:

1. An emergency within the meaning of Section 202 of the Federal Power Act exists in the production of electrical energy in the United States due to the virtual cessation of coal mining and depletion of coal stocks on hand.

2. Coordination of operations between various electric utility systems, by means of interconnections and otherwise, to take fullest advantage of available hydroelectric sources and fuel sources other than coal, will make possible the conservation of existing stocks of coal.

3. The use of interconnections for the purpose of alleviating the critical coal situation during the present emergency in accordance herewith shall not affect the jurisdictional status of electrical utilities under the Federal Power Act.

4. The finding and determination is expressly limited to the use of inter-connections for the relief of the emergency resulting from the depletion of coal stocks, and all exemption provided hereby shall terminate 30 days following the cessation of the present emergency as determined by the commission.

The commission accordingly recommends to all publicly and privately owned electric utilities that, to the extent that such action will assist in meeting the present emergency,

a. The use of electricity for all purposes be curtailed to the extent feasible

Westinghouse Strike Ends

After 115 days, the Westinghouse strike was settled at 3:20 p. m., Thursday. Workers will return as soon as terms of settlement and new contracts are ratified.

Union employees will get an 18 cents an hour raise. An additional one cent an hour will go into a fund to narrow the differential between men and women.

In place of a fluctuating bonus, day workers will get in the base rate a guaranteed fixed amount representing between 42 and 75 percent of that paid last December.

Maintenance of membership is retained with opportunity for workers to withdraw from the union next month without penalty. Those who have withdrawn since March 24 will not be penalized.

and consistent with the public safety and the maintenance of essential public services.

b. Electric utilities interconnect and coordinate their operations to the extent necessary to assure the maximum conservation of fuel supplies in areas threatened with shortages in the present emergency.

Industrial and business establishments in Illinois and northern Indiana were operating on a 24-hour-a-week schedule as the result of power curtailment edicts issued last week by state regulatory commissions.

The Public Service Commission of Indiana followed Wednesday's action by the Illinois Commerce Commission with an order issued May 2 at the request of Northern Indiana Public Service Co., Hammond, curtailing service to 22 northern Indiana counties including the steel-producing Calumet area adjoining Chicago.

The order, substantially identical to that of the Illinois regulatory body, restricted industrial use of electricity to an aggregate of 24 hours from Monday through Friday and commercial use to the hours of 2 to 6 p.m., Monday through Saturday. While up to Friday the order applied only to the area served by the Northern Indiana Public Service Co., downstate utilities were studying their operations with a view to a possible appeal for a restriction order if no break appeared in the coal strike deadlock.

Commonwealth Edison officials announced that they have ordered oil burning equipment for installation at Fisk and Northwest stations in Chicago. The first burners are expected to arrive on May 10. Conversion of four boilers at Fisk station to oil operation would make 225,000 kw. of the station's 323,000 kw. of capacity independent of coal. At Northwest station oil burning equipment is contemplated for boilers supplying turbo-generators of 135,000 kw. Capacity of Northwest station is 215,000 kw. Since no oil storage facilities are available at these stations it will be necessary to draw oil directly from tank cars into the furnaces, it was stated.

Boilers at Crawford and Calumet stations are not adapted for quick conversion to oil operation, it was explained. Such changes would involve alterations that could not be completed in time to be of use in the present situation, it was reported.

Over the last week end and up to 7 a.m. Monday, 158,000,000 cu. ft. of gas was made available by the Peoples Gas Light and Coke Co., Chicago, for use in boilers at Calumet and State Line station. This amount of gas was equivalent to about 158 carloads of coal or about 7,900 tons, it was stated, and affected a corresponding saving in the utility's coal reserves.

Detroit has revived a 1920 ordinance directing that non-essential use of electricity in offices, factories, and homes be curtailed, and forbidding use of electricity for outdoor decorative, advertising, and display lighting. Restrictions on outdoor lighting are similar to Order U-9 and carry a penalty for non-compliance of up to $500 fine or 90 days in jail.

Washington, D. C., served by the Potomac Electric Power Co., has browned out, and President Truman ordered the White House to comply with the order. Plans have been made to shut off the air-conditioning system.

In New Jersey and Pennsylvania, the public utility commissions have indicated that they will act to support any utility which makes a request to curtail service.

POWER SAVINGS DURING FIRST WEEK OF CHICAGO AREA DIMOUT
(Data applies to Commonwealth Edison group of companies only)

	Actual Daytime Peak, kw.	Normal Daytime Peak, kw.	Actual Use kw.-hr.	Normal Use kw.-hr.	Tons Coal Saved	% Load Reduction Av.
May 2, Thursday	1,766,000	1,840,000	31,108,000	32,800,000	1,500	5.1
May 3, Friday	1,514,000	1,780,000	27,123,000	33,000,000	4,400 900*	17.5
May 4, Saturday	951,000	1,360,000	19,863,000	26,400,000	4,500 3,100*	25.0
May 5, Sunday	884,000	1,216,000	13,795,000	19,400,000	4,200 3,900*	32.0
May 6, Monday	1,280,000	1,740,000	21,461,000	31,000,000	6,900 2,400*	30.8
May 7, Tuesday	1,240,000	1,780,000	19,938,000	32,500,000	9,100 3,200*	38.7
May 8, Wednesday	1,160,000	1,760,000	19,170,000	32,000,000	9,000 3,600*	40.1

*Additional tons of coal saved on this day because of use of gas.

INFORMATION PLEASE—Inquiries from customers about the effect of the brownout on their operations are answered by 40 men in the Customer Order Division of the Commonwealth Edison Co. The calls totalled 12,928 on the first day after the order was issued and 9,108 on the second day

Emergency Controls Office Established at Washington

The Civilian Production Administration has organized an Office of Emergency Controls and staffed it with former Office of War Utilities experts to handle problems arising out of curtailed fuel stocks of electric and gas utilities. Edward Falck, for a year and a half director of OWU, heads the new organization.

Other electric power consultants who have been recalled temporarily include Charles Collier, Georgia Power Co.; Chandler W. Jones, New England Power Association; William A. Lyons, assistant to the president of the New York State Electric & Gas Corp.; Walker Cisler, chief engineer of Power Plants, Detroit Edison Co.; J. E. Moore, of Ebasco Services, Inc.; M. B. Covell, purchasing agent for Union Electric Co. of Missouri; Carl Johns, of the Wisconsin Public Service Co.; O. L. Hopper, associated with Falck in private consulting work; H. G. Thielscher, of the Potomac Electric Power Co.; and George E. Doying, Jr., of the McGraw-Hill Publishing Co.

Oil Would Aid in Keeping Coal Using Utilities on Line

Government Survey Shows Virginia, Washington, and Chicago Areas Having Greatest Fuel Difficulties

If the electric utilities in New England, the Middle Atlantic States, and the Middle West could be assured of the delivery of 60,000 barrels of oil daily, electric power supply in predominantly coal-fired areas would not be in difficulty because of the coal strike except in Virginia, Washington and the Chicago district.

This was the conclusion arrived at this week by a group of government experts who surveyed the fuel-supply picture of major coal-fired systems.

As of May 6, the survey showed:

Major Massachusetts systems have 32 days' supply of coal. Their picture could be improved through delivery of oil. South of Boston, supplies are generally about 45 days, except for one system with 22 days. Assured delivery of 20,000 bbl. of oil daily would extend the coal supply immensely.

Connecticut companies have 45 to 60 days' supply. Transit time for coal delivery in New England is 15 to 20 days.

New York Conditions

Upstate New York properties have 70 days' supply. Consolidated Edison Co. has 31 days' which could be stretched 5 or 8 days more by maximum imports from upstate and delivery of 4,000 bbl. of oil daily. Transit time for Consolidated Edison is 15 days. Long Island has 10 days' of oil and 30 days' of coal. With 3,000 bbl. of oil daily it could stretch its fuel supply to 65 days.

New Jersey companies have from 25 to 42 days' supply. If its oil deliveries were tripled to 21,000 bbl., one system could figure on a 100 days' supply of fuel. Another system is planning a 25 percent cut in industrial deliveries on May 15.

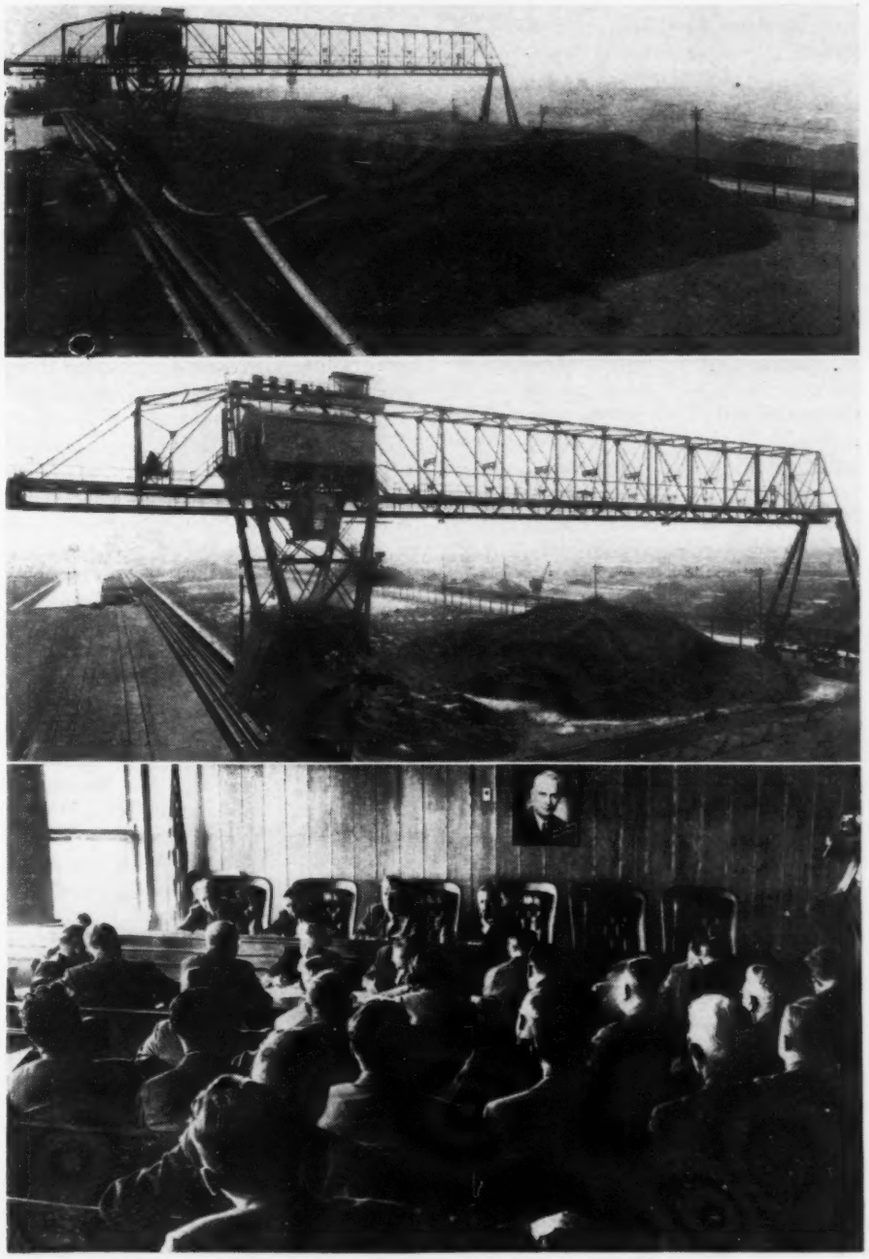
Eastern Pennsylvania systems burning anthracite have 70 days' supply and are still receiving shipment. These companies are exporting 100,000 kw. around the clock.

Philadelphia reported a 28-day supply, with effective voluntary curtailment and industrial load which has been lost having taken about 60,000 kw. off the load. Delivery of 15,000 bbl. of oil daily would stretch out its fuel supply to about 46 days.

Other Middle Atlantic States systems reported 30- to 40-day supplies. A mandatory curtailment program is in effect in Washington where the Potomac Electric Power Co. has received several days' supply from the solid fuels administration. The curtailment has effectively "browned out" downtown Washington, but little saving is available from curtailed industrial loads. It was hoped to cut consumption 20 percent by the first step of the curtailment order issued May 4.

Western Pennsylvania systems reported 25 to 42 days' supply without the mine loads. West Penn Power Co. has one small mine operating. In Northern Ohio, stocks ran as high as 55 days' and as low as 30 days'. Southern Ohio systems reported stocks as high as 77 days' and as low as 26 days'. Lines from the south into Cincinnati are loaded to capacity and are furnishing 210,000 kw. around the clock. In Michigan, supplies range from 33 to 94 days, with some stretch-out of the smaller number possible without curtailment.

Illinois companies reported supplies



WHEN THE COAL PILE DWINDLED—Back in August, 1942, the Loomis Street coal pile of the Commonwealth Edison Co. contained 240,000 tons (top). By April 30, 1946, the pile was down to 15,000 tons (center); so Commonwealth Edison and its affiliates appealed to the Illinois Commerce Commission for authority to curtail service. The bottom picture shows Commissioners Frank Peska, Edwin Rosenstone, Chairman John D. Biggs, and William Parillo on the bench from left to right at the hearing which resulted in curtailed service for commercial and industrial power users

from 50 days down to the level of the Chicago district. Iowa systems ranged from 60 to 70 days'. St. Louis reported 22 to 24 days', with some resources short of curtailment. In Indiana, stocks ranged from 18 to 60 days,' with only one system really short. Kentucky reported 60 to 70 days', with supplies coming in from TVA and being moved on to the North. Wisconsin reported 59 to 65 days' and Minnesota 30 to 80 days', depending on water supply. Chicago reported 15 days.

In the Southeast, supplies of more than two months were reported, with much of the generation now coming from hydro plants and little coal being burned. Ties to the North are loaded to capacity generally entirely with hydro energy. Only tight spot seemed to be on the Virginia Electric & Power Co. system, which had 20 days' after maximum deliveries from the Carolinas.

•

REA Section to Promote Electro-Farm Equipment

Set up in the Technical Standards Division of the Rural Electrification Administration, the new Electro-Agriculture Section will organize, promote, and coordinate programs in the development of new electro-argicultural equipment and the improvement of existing devices of benefit to the farmer. The section will work with colleges and research groups and make the information available to manufacturers for commercial production.

J. P. Schaenzer will head the new section. Before coming to REA in 1941, he had experience as project director of rural electrification at the University of Wisconsin, with the Federal Power Commission, and with Edison Electric Institute where he headed the Rural Service Division.

•

Canadian Output Statistics

The Dominion Bureau of Statistics has released the following output statistics of Canadian central electric stations in thousands of kilowatt-hours:

Period	1946	1945
Two Months	6,611,784	6,546,918
Primary	5,419,376	5,559,463
Secondary	1,192,408	987,455
Exports to U. S.	377,183	317,129
February	3,183,011	3,124,235
Primary	2,594,679	2,645,482
Secondary	588,332	478,753
Exports to U.S.	178,661	152,659
January	3,428,773	3,422,683
Primary	2,824,698	2,913,981
Secondary	604,075	508,702
Exports to U. S.	198,522	104,470

House Committee Slashes Funds for Public Power

Appropriations Committee Reduces 1947 Grants to Interior Department by $172,113,251—Bonneville, SPA, and Reclamation Bureau Affected—Congress However Likely to Restore Cuts

THE public-private power ownership fight in the Southwest reached the action stage this week as the House Appropriations Committee reported a drastically slashed 1947 Interior Department Appropriation Bill which

1. Cut $20,025,000 from the $23,323,000 requested for the Southwest Power Administration.

2. Cut $94,622,580 from the $166,894,055 requested for the Bureau of Reclamation.

3. Cut $10,791,000 from the $19,791,000 requested for the Bonneville Power Administration.

4. Cut $172,113,251 from the entire Interior appropriation request, of which $125,438,580 came from the Bonneville, Reclamation, and Southwestern Power items.

Chances that Congress will fail to restore substantial amounts of the House Committee slashes are virtually nil, Capitol observers believe. In recent years, the House Appropriations Committee has cut Interior appropriation requests substantially, only to have the House and Senate restore large portions of the cuts, with the Conference Committee splitting the difference.

SPA Hardest Hit

Heaviest hit of the three agencies was the Southwestern Power Administration, whose manager, Douglas Wright, virtually told the committee that if Congress were not prepared to grant the entire $23,000,000 request, it should not grant any of it, since the job should be done completely or not at all.

The SPA item, first construction appropriation for a system which is ultimately planned to reach five states and cost $200,000, will probably provoke the fiercest floor fight of any of the power items, for Speaker Sam Rayburn served notice some time ago that he would fight any cut in the request.

In its report on the bill, the committee asserted that it "does not favor the initiation of a power-development program in this area the cost of which would approximate such an enormous sum," and added that it could not find any "satisfactory justification" for the two steam plants which were proposed for SPA's system at Gilmer, Tex., and Lake Charles, Ark.

In all three of the slashed power items, the committee moved against transmission lines proposed for construction or acquisition by the various agencies. In the Bonneville item, it removed language regarding the acquisition of transmission lines and reduced to 115 kv. the authorized capacity of the Kerr Dam-Hungry Horse Dam construction site line. It disapproved the 115-kv. Colfax-Spokane line.

In discussing its action on the Reclamation item, the committee noted that it had warned Interior Secretary J. A. Krug against over-emphasis on electric power by Reclamation Bureau programs, and it added that Krug had taken what it termed a "fair position" in the matter.

Citing the Central Valley project as an example, the committee spoke out against increases in project costs from authorized levels. Central Valley originally was estimated to cost $170,000,000, is now estimated to cost $384,314,000, and may reach an ultimate cost of $1,800,000,000 according to reports received by the committee. It then specifically denied funds for transmission lines proposed by the Bureau in connection with the Parker Dam, Colorado-Big Thompson, and Fort Peck projects.

In the SPA item, it allowed funds for a line from Denison Dam to Ada, Okla., but eliminated funds for a line from Ada to Markham Ferry Dam, in northwestern Oklahoma.

Committee Approvals Listed

Construction programs approved for Bonneville and SPA follow:

System projects carried forward from earlier years, $5,724,000; Detroit-Chemawa 115-kv. line, $1,287,000; Hungry Horse-Kerr Dam 115-kv. line, $950,000; feeder extensions, service and miscellaneous additions, $500,000; advance surveys and design, $150,000; tools and equipment purchases, $200,000; total construction, $8,811,000.

Southwestern Power Administration:

Denison Dam to Ada 132-kv. line, $500,000; feeders, connections and additions in Texas and Oklahoma, $2,548,000; future plans and specifications, $25,000; general plant and equipment, $25,000; administration and general construction expenses, $100,000; total construction, $3,198,000.

Copper Situation Serious; Manufacturers Face Shutdowns

Failure of OPA to Agree to Higher Prices Blocks Settlement of Strikes—Many Companies Have Already Curtailed Operations—Others Expect to Follow—Industry Reconversion Slowed

WARNINGS came from the electrical manufacturers this week that unless the strikes in the copper industry are settled immediately, they will be forced to close their plants, and reconversion already greatly delayed by strikes in their own plants and in the steel and coal industry will be still further away.

Stumbling block to the settlement of the strikes in the copper mines is the refusal of the Office of Price Administration to give its consent to what the industry considers a necessary price if wages are to be raised. The present ceiling price of copper is 12 cents a pound. This was established in August, 1941. OPA is reported to be willing to raise this to 14 cents a pound, but the industry feels that 15 cents must be the minimum.

Charles E. Wilson, president of General Electric Co., said this week that the shortages of copper and steel have been so severe that G.E. plants have already curtailed production. He explained that his company is receiving far less than its total copper requirements and that it is receiving no shipments at all of some types, creating a very unbalanced condition in the factories. He emphasized that "copper is required for the manufacture of practically all of our lines of products."

Since the latter part of January, the two largest mines which produce approximately 75 percent of the domesticated copper have been closed. Refineries producing about 90 percent of the refined copper have been closed since February. About 80 percent of the available copper-processing facilities have been closed for an even longer time, Mr. Wilson declared.

A similar statement was made by J. W. Corey, president of the Reliance Electric & Engineering Co., who said that the copper shortage has already forced his company to cut operations from 48 to 32 hours a week. A complete shutdown is likely by June 1.

"The situation is very critical," Mr. Corey said. "Even after copper starts flowing from the mines to the smelters, it will take about six weeks before it reaches such manufacturers as Reliance. This means that if the flow isn't started by June 1, the plants likely will be shut down during June and most of July, despite the fact that the backlog of orders for electric motors, according to the Civilian Production Administration, is far in excess of production."

Practically all major manufacturers of electrical motors and supplies in the Cleveland area will be shut down tight within a period of three weeks for lack of copper regardless of the growing scarcity of steel or settlement of the coal strike.

A few of the manufacturers are not receiving 25 percent as much copper as in normal times; others have had their source of supply, especially copper rods and wire, completely shut off because of the labor difficulties being experienced in the copper industry.

Clark Controller Co., builder of electrical controls, while operating at capacity at present, has sufficient supplies of copper on hand to maintain their present rate of production for a scant 30 days. Apex Electric Manufacturing Co., builders of household appliances, sees ten days as the maximum at which the plants can operate unless supplies of both copper and steel are uncovered and made available immediately.

Ohio Electric Co., builders of motors, are so hard put to find copper that odd sizes are being eagerly grabbed up and reworked in the plant to bring heavy sheets down to size. In the face of such a makeshift operation, three to four weeks is the most that production can be maintained.

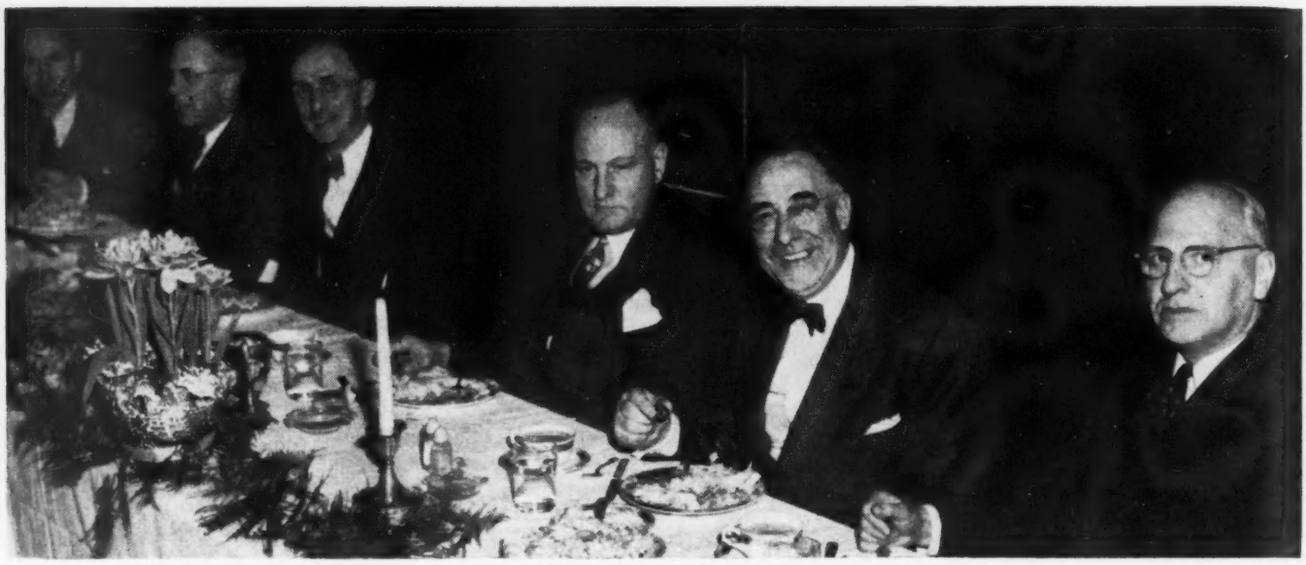
Officials at Clark Controller Co. admit a growing nervousness on the copper situation. Users of large quantities in the product control instruments they build. officials see a none too plentiful inventory diminishing at an alarming rate.

C. G. Franz, president of Apex Electrical Manufacturing Co., household appliance manufacturers, sees his company facing another shutdown within the next ten days because of lack of both copper and steel. Apex only recently resumed operations after an enforced idleness of several weeks because of lack of steel. Unable to build up an adequate inventory since the settlement of the strike, the company now faces the additional burden of securing copper. It is as important to us to settle the copper strike as the coal strike, Franz said.

The Ohio Electric Co. has used a number of ingenious methods in sizing and shaping copper, purchased recently in odd lots, to meet their needs.

Curtailment on an increasing scale is also threatened in the Greater Boston area. Simplex Wire & Cable Co. has been short of copper for months, is now receiving small deliveries approximating 25 percent of normal, and is operating at about 50 percent of pre-shortage output. The Tirex Department has been kept at work as it calls for maximum man-hours

IMPETUS GIVEN FARM POWER—Participants in the recent four-day gathering of the New England Rural Electrification Institute held at Massachusetts State College at Amherst under the auspices of the Farm Electric Service Committee of the New England Council. Utility men, educators, manufacturers' representatives, and government officials took part



SALES TRAINING IN BOSTON—Electric Institute of Boston ended its first basic sales training course on April 12 with the award of 129 certificates. Taking an active part in the program were Harding U. Greene, left, vice-president and general manager, Cambridge Electric Light Co.; George C. King, sales manager of Boston Edison Co.; John G. Waddell, managing director of the Electric Institute, Boston; H. T. Anderson, Paine Furniture Co., Boston; H. J. Erath, director of the course; and George H. Wahn, Boston wholesaler

of employment, but throughout the plant shortages point to at least a two-weeks stoppage of all production by the last week in June. American Steel & Wire Co. cable works in Worcester closed May 6 for two weeks. Deliveries quoted on resumption of copper supply mean little.

Boston Works of Allis-Chalmers in Hyde Park, now on strike influenced by the parent plant situation in Milwaukee, is seriously handicapped as to supply of copper for circuit breakers. General Electric's Lynn plant, despite fair stock of copper accumulated during recent nine-weeks strike, faces sufficient exhaustion of this material and other materials to require curtailment in probably four to five weeks at the outside. Two-weeks complete shutdown is planned for mid-July.

Anchor Manufacturing Co., Boston, can maintain full production about three weeks more; steel sheets still tight and freight embargo will greatly hamper deliveries. Sylvania Electric Products Inc., can probably run through to June on present copper stocks, although handicapped by transportation outlook.

B. F. Sturtevant Co. is feeling copper shortage keenly in pipe coil and electrical material production, although running full capacity this week. General Radio has four to five-weeks copper supply, but long-range outlook is unsatisfactory. Chase-Shawmut Co., Newburyport, reports being fortunate to May 7, but in 10 to 14 days more is likely to feel the shortage pinch with increasing severity though all possible effort will be made to maintain production.

Ohio Edison Will Increase Gorge Plant to 147,000 Kw.

Ohio Edison Co. will construct a $4,000,000 addition to its Gorge plant in Akron, President Walter H. Sammis has announced.

The addition will consist of a 44,000-kw. steam turbine unit and a boiler with a capacity of 45,000 pounds per hour. Powdered coal will be used for fuel. The new equipment is to go into operation in the fall of 1948.

The new unit will be of the same size as that which was installed in the Gorge plant on the Cuyahoga River in 1943 but will embody later improvements. After the installation the plant will have a capacity of 147,000 kw. Construction will not start until 1947.

MEETINGS

Previously Listed

Arkansas Utilities Association—Annual convention, Arlington Hotel, Hot Springs, Ark., May 13-14. R. E. Ritchie, secretary, Arkansas Power & Light Co., Little Rock, Ark.

Southeastern Electric Exchange—Residential and home service conference, Atlanta Biltmore Hotel, Atlanta, Ga., May 14-15; spring power sales conference, Battery Park Hotel, Asheville, N. C., May 23-24. J. W. Talley, executive secretary, 303 Haas-Howell Bldg., Atlanta, Ga.

Pennsylvania Electric Association—Commercial committee, New Castle, Pa., May 23; A. G. Garrigues, chairman, Philadelphia Electric Co., Philadelphia, Pa. Rural committee, State College, Pa., May 23-24; W. H. Ferguson, chairman, Duquesne Light Co., Pittsburgh, Pa. Engineering Section, all committees, Penn Harris Hotel, Harrisburg, Pa., May 28-29; E. B. Shew, chairman, Philadelphia Electric Co., 900 Sansom St., Philadelphia, Pa.

Great Lakes Power Club—Spring meeting, Palmer House, Chicago, Ill., May 24. Almer Skretting, secretary-treasurer, Wisconsin Electric Power Co., Milwaukee 1, Wis.

New Jersey Utilities Association—Spring meeting, Seaview Country Club, Absecon, N. J., May 24-25. Harry Bacharach, executive director, Atlantic City, N. J.

Edison Electric Institute—Annual convention, Waldorf Astoria Hotel, New York, N. Y., June 3-5. Col. H. S. Bennion, managing director, 420 Lexington Ave., New York 17, N. Y.

National Fire Protection Association—Annual meeting, Hotel Statler, Boston, Mass., week of June 3. R. S. Moulton, technical secretary, 60 Batterymarch St., Boston 10, Mass.

Pacific Coast Electrical Association—Annual convention, Fairmont Hotel, San Francisco, Calif., June 12-14. V. W. Hartley, managing director, 447 Sutter St., San Francisco 8, Calif.

National Electrical Manufacturers Association—Special sections meetings, The Homestead, Hot Springs, Va., June 17-19. W. J. Donald, managing director, 155 E. 44th St., New York 17, N. Y.

American Society of Mechanical Engineers—Semi-annual meeting, Book Cadillac and Statler hotels, Detroit, Mich., June 17-20. Ernest Hartford, executive assistant secretary, 29 W. 39th St., New York 18, N. Y.

American Society of Agricultural Engineers—Annual meeting, New Jefferson Hotel, St. Louis, Mo., June 24-26. Raymond Olney, secretary, St. Joseph, Mich.

American Institute of Electrical Engineers—Summer convention, Hotel Statler, Detroit, Mich., June 24-28. H. H. Henline, secretary, 33 W. 39th St., New York 18, N. Y.

American Society for Testing Materials—Annual meeting, Buffalo, N. Y., June 24-28. R. E. Hess, assistant secretary, 260 S. Broad St., Philadelphia 2, Pa.

Canadian Electrical Association—Annual meeting, Banff Springs Hotel, Banff, Alberta, Canada, June 26-28. B. C. Fairchild, managing director, 704 Tramways Bldg., Montreal 1, Que., Canada.

Home Freezer Research Underway at Cornell Univ.

A study of community and home frozen food services, equipment, and operation has begun at Cornell University, Ithaca, N. Y. Cooperating with the university are nine New York state public utilities and five leading distributors of food freezing and storage cabinets.

The five national manufacturers and suppliers of food freezing and storage cabinets for farm and city homes have agreed to give Ithaca and surrounding Tompkins County No. 1 priority on all such equipment that residents wish to buy or rent.

Companies cooperating are the Carrier Corp., the Philco Corp., Sears, Roebuck & Co., Emil Steinhorst & Sons, Utica, and the Cooperative Grange League Federation Exchange, Ithaca. The last owns and operates Ithaca's pilot food freezing and processing plant, Mother Zero.

In return, residents will act as "guinea pigs" in answering, on the basis of personal experience, questions relating to every phase of use of the cabinets. The information will be gathered and integrated by experienced interviewers from the Cornell University School of Nutrition.

In addition to the Consolidated Edison Co., which initiated support of frozen food research at Cornell in 1942, the utilities which have joined to support financially the Cornell School of Nutrition are Buffalo Niagara Electric Corp., Central Hudson Gas & Electric Corp., Central New York Power Corp., Long Island Lighting Co., New York Power & Light Corp., Niagara, Lockport & Ontario Power Co., Rochester Gas & Electric Corp., and New York State Electric & Gas Corp.

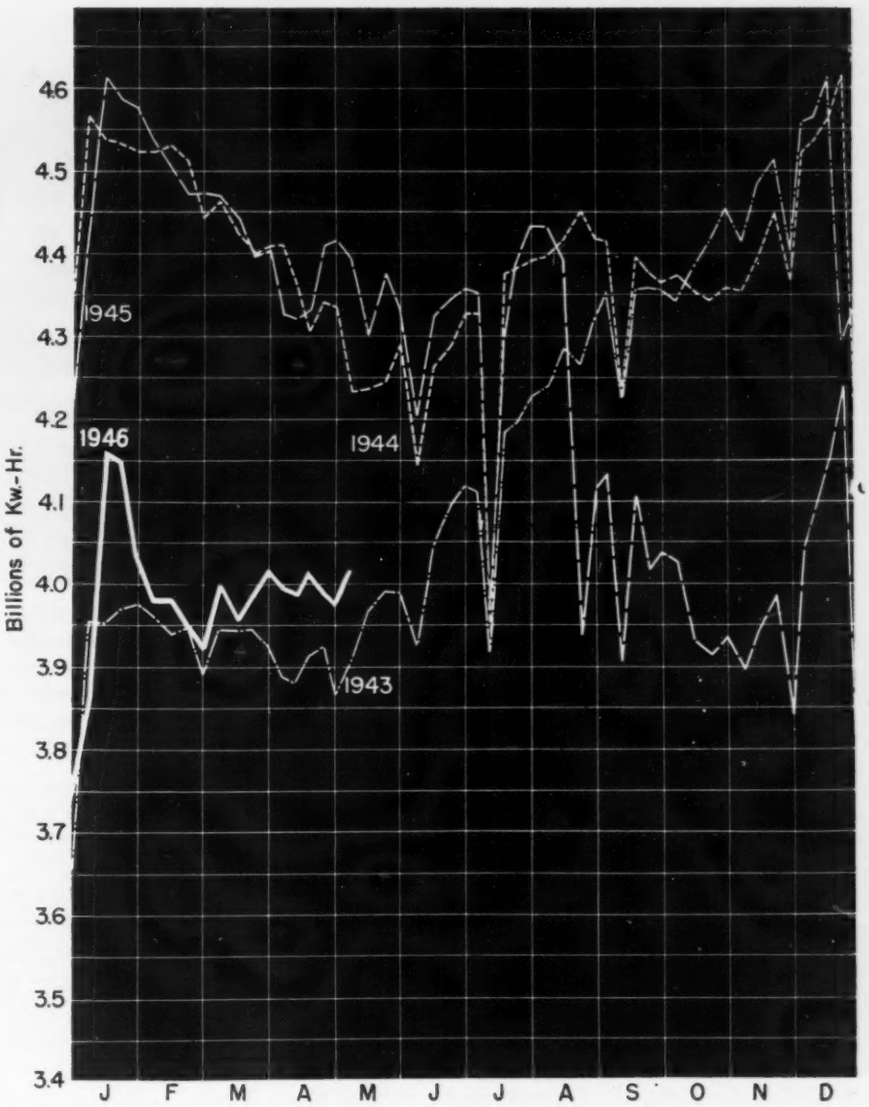
•

A.W.B. Provides Material for Home Wiring Studies

A series of four lessons in improving wiring in the home is now ready for distribution at a nominal cost by the National Adequate Wiring Bureau, 155 E. 44th St., New York 17, N. Y.

Designed for teachers of home economics, the lessons cover and provide the answers to four questions: "How Can This Room Be Improved?", "What Are This Kitchen's Electrical Needs?", "What Are This Laundry's Electrical Needs?" and "Which House Would YOU Pick?"

Each student in the class is to be given a questionnaire, and a teacher's supplement provides the correct answers.



Electric Output Curve Moves Slightly Upward

The electric output curve turned upward during the week ended May 4, 1946, according to figures released by the Edison Electric Institute. The amount of electrical energy distributed by the light and power industry totaled 4,011,670,000 kw.-hr., compared with 3,976,750,000 kw.-hr. during the preceding week. During the week ended May 5, 1945, the amount of electrical energy distributed amounted to 4,397,330,000 kw.-hr., this year's figure representing a decrease of 8.8 percent.

All of the seven major geographical regions of the country reported losses for the week ended May 4 as compared with the corresponding week of last year. The largest decrease was shown by the Central Industrial group, which reported a drop of 12.2 percent. The Pacific Coast states showed the second largest decrease—10.7 percent—with the Southern States running a close third—9.2 percent.

Weekly Output, Millions Kw.-Hr.

1946		1945		1944	
May 4	4,012	May 5	4,397	May 6	4,234
Apr. 27	3,977	Apr. 28	4,416	Apr. 29	4,336
Apr. 20	3,987	Apr. 21	4,411	Apr. 22	4,344
Apr. 13	4,015	Apr. 14	4,332	Apr. 15	4,307
Apr. 6	3,988	Apr. 7	4,322	Apr. 8	4,361
Mar. 30	3,992	Mar. 31	4,329	Apr. 1	4,409
Mar. 23	4,017	Mar. 24	4,402	Mar. 25	4,409
Mar. 16	3,988	Mar. 17	4,398	Mar. 18	4,400
Mar. 9	3,953	Mar. 10	4,446	Mar. 11	4,426
Mar. 2	4,000	Mar. 3	4,472	Mar. 4	4,465
Feb. 23	3,923	Feb. 24	4,474	Feb. 26	4,445
Feb. 16	3,949	Feb. 17	4,472	Feb. 19	4,512

Percent Change from Previous Year

	Week Ending		
	May 4	Apr. 27	Apr. 20
New England	— 4.1	— 2.2	— 2.3
Mid-Atlantic	— 3.1	— 3.7	— 3.0
Central Industrial	—12.2	—12.9	—11.0
West Central	— 5.6	— 5.1	— 4.1
Southern States	— 9.2	—11.8	—12.3
Rocky Mountain	— 3.2	—13.1	—14.1
Pacific Coast	—10.7	—10.9	—12.6
Total United States	— 8.8	— 9.9	— 9.6

SEC RULINGS

The Securities and Exchange Commission recently issued a series of orders affecting electric utility companies.

UTAH POWER & LIGHT Co.'s proposal to issue and sell $32,000,000 of new first mortgage bonds and $11,500,000 of bank notes for the purpose of refunding $38,500,000 of outstanding first mortgage bonds and $5,000,000 of 6 percent debentures has been approved. The commission retains jurisdiction over the result of the competitive bidding. The bank notes will bear 2 percent interest and will be repaid in semiannual installments of $500,000 each until May 1, 1956, when a final payment will be made in the amount of $2,500,000. The outstanding bonds are to be redeemed at 104¾ percent and when Utah's $5,000,000 principal amount of 6 percent gold debenture bonds, Series A, become subject to redemption on May 1, 1947, they will be redeemed at 110 percent. (Release No. 6555)

OGDEN CORP.'s proposal to use approximately $3,000,000 of its cash resources not needed for other corporate purposes, for investment in securities other than of public utility companies has been approved, subject to certain minor conditions. (Release No. 6564).

MISSISSIPPI POWER & LIGHT Co. and its parent, Electric Power & Light Corp.'s joint proposal, whereby Mississippi will issue and sell 200,000 additional common shares to Electric for $2,500,000 in cash, has been permitted to become effective. (Release No. 6581).

AMERICAN GAS & ELECTRIC and SCRANTON ELECTRIC'S joint application-declaration, outlining a program for refinancing the latter's outstanding preferred stock and for divesting the former of its interests in Scranton Electric has been approved by the commission. Scranton Electric will amend its charter to reduce its authorized 100,000 shares of no par value $6 cumulative preferred stock, of which 53,248 shares are outstanding, to 75,000 shares of $100 par value cumulative preferred stock, and will reclassify its authorized 2,500,000 common shares of no par value, all owned by American Gas & Electric, into 1,500,000 shares of $5 par value, of which 1,214,000 will be owned by American Gas & Electric. Scranton Electric then will sell the new preferred stock at competitive bidding and will use the proceeds, with treasury funds, to redeem its outstanding preferred at $110 a share plus accrued dividends. In compliance with a previous order of the commission, American Gas & Electric will divest itself of all interest in Scranton Electric and certain of its other subsidiaries. (Release No. 6565).

POTOMAC EDISON Co.'s joint application-declaration with four direct subsidiaries, outlining a plan for merging three of the latter into the fourth, has been approved. The subsidiaries are the Northern Virginia Power Co., which will survive; Page Power Co., Madison Power Co. and the Massanutten Power Co. Transactions involved in the program include: (1) Potomac will transfer to Northern Virginia all the outstanding capital stocks of Page, Madison and Massanutten in exchange for 19,560 shares of $100 par value common stock of Northern Virginia, plus or minus, as the case may be, ten additional shares of such stock for each $1,000 of the net amount of certain adjustments; (2) Potomac also proposes to purchase 6,810 additional shares of Northern Virginia's common stock for $681,000; (3) Northern Virginia will retire outstanding indebtedness to Potomac in the aggregate amount of $681,774; (4) Northern Virginia proposes also to surrender to the issuing companies for cancellation and retirement all outstanding shares of capital stock of Page, Madison and Massanutten. (Release No. 6586).

ILLINOIS POWER Co.'s application requesting exemption from the provisions of section 6(A) of the Public Utility Holding Company Act of 1935 regarding the sale at competitive bidding of $45,000,000 of first mortgage bonds, due in 1976, and $9,000,000 of sinking fund debentures, due in 1966, has been approved. The commission stipulated that the sale of the bonds and debentures should not be consummated until the results of the competitive bidding are supplied by an amendment. (Release No. 6570).

FARM ELECTRIFICATION COURSE—This is a typical session of the three-day short course in farm electrification recently conducted by the University of Wisconsin at Madison. The program was planned by a six-man committee of utility and REA people in cooperation with the faculty of the Agricultural Engineering Department of the University

UTILITY REPORTS

	Net Income 1946	1945
*Alabama Power	$5,990,227	$6,937,087
*Central Arizona Lt. & Pwr.	1,041,985	742,251
*Commonwealth Edison and subs	27,087,178	22,941,300
*Consolidated Edison Co. (N. Y.) and subs	34,351,911	33,877,911
*Consolidated Gas Elec. Lt. & Pwr. (Balto.) and sub	6,919,345	5,978,554
*Consumers Power	8,826,937	7,122,337
*Dallas Power & Light	1,537,794	1,487,141
†Engineers Public Service and subs	10,770,538	10,565,306
*Georgia Power	6,035,659	4,895,917
*Ohio Edison	4,509,543	3,505,813
*Philadelphia Electric and subs	18,701,582	17,173,044
*Tampa Electric	1,345,940	1,255,813

* Twelve months ended March 31.
† Twelve months ended February 28.

Telluride Power to Spend $150,000 for Improvements

Telluride Power Co., Richfield, Utah, has authorized expansion and reconstruction expenditures totaling $150,000 for 1946, Paul P. Ashworth, general manager, has announced.

Included are Richfield, a new 1,500-kw. substation with 44,000-volt oil circuit breaker, control house and operator's cottage, service shop, warehouse, and an ultra-modern kitchen for use by dealers and the company for demonstrations; Milford, new substation and switching facilities; Beaver, automatic oil circuit breakers in 44,000- and 7,200-volt lines, reconstruction of dam and sections of pipe line, transmission line rearrangements, and switching facilities, with new 44,000-volt transmission service in Beaver Canyon; Fillmore-Richfield, restringing of 44,000-volt line and replacement of present conductors.

•

Utah Power Buys Utility

Purchase of the Little Lost River Power & Light Co. of Arco, Idaho, by the Utah Power & Light Co. has been recently reported. The Little Lost River Power Co. was formed several years ago when Arco constructed a transmission line to Hamer and operated it as a cooperative.

Utah Power announces plans to extend service to include many ranches in the Upper Lost River Valley.

HOW

DESIGN • CONSTRUCT • OPERATE • MAINTAIN

Lever Device Turns Converter Armature

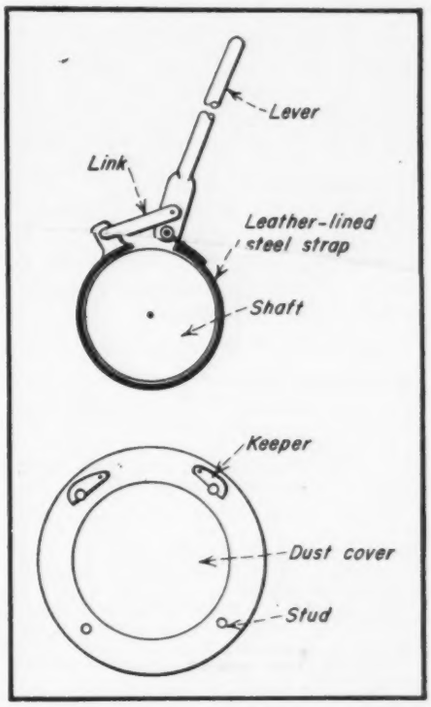
It's not easy to turn the armature of large rotary converters by hand a few degrees at a time as is necessary, for example, in undercutting mica on the commutator. Trouble is there are too few good "hand holds" on the armature and maintenance men are tempted to use the coil ends for the purpose and so distort them.

TURNING DEVICE in use during maintenance operations on rotary converter; fully hand operated

The substations maintenance department of the Northern Indiana Public Service Co., Hammond, has solved the problem by equipping each of these converter stations with a special armature turning lever, shown, that fits around the outboard end of the converter shaft.

A light clockwise tug on the lever of the device clamps a leather-lined light steel strap around the shaft. Further clockwise force on the lever locks the strap tighter and tighter on the shaft, permitting the armature to be turned with ease. The device is released from the shaft by simply "backing off" on the lever.

End of the converter shaft on which the device is used is normally covered with a dust cap. Originally this was held in place with four cap screws. But to make it easy for maintenance men to remove the cover, the cap screws were replaced with studs, two of which project outward from the flange of the cover and are notched to take "keepers" that lock it in place. The other studs are flush with the flange of the cover and serve only to position the cap.



ARMATURE TURNING DEVICE clamps around end of converter shaft permitting armature to be turned by hand a few degrees at a time as desired to undercut mica

• • •

Duties of a Field Inspector, Distribution Department*

In this company the field inspector is directly responsible to the superintendent of distribution, and is to be found, whenever possible, in the general office of the department every working day from 8:30 a.m. to about 10 a.m. If he has anything to report, he presents it to the superintendent on the first working day of every week at 9:30 a.m. Such matters include any discrepancies between material as laid out and that required for the work as planned, under way, or done, discrepancies in records, or other occurrences. His major function is to inspect all finished construction in the field to determine (1) that proper accounting has been made of all material used, returned or retired; (2) that complete and accurate reports have been made for necessary engineering and distribution records; (3) that all construction has been done according to standard requirements. Special care is required in checking work for which outside concerns or persons are to be billed.

Each morning this inspector receives from department heads all work orders, stock records, retirement records, plans, field maps, pole record reports, transformer record tags, table records and other data covering the work of the previous day. He examines these and calls the attention of the proper department head to any obvious errors or omissions. After obtaining an apparently complete collection of records and reports covering a particular job, he visits the place where the work was done. Here he checks as closely as possible the material used and that retired. He observes all conditions, checking as fully as possible all electrical and mechanical details with the plans, reports, tags, etc., turned in, noting needed corrections and departures from standard specifications. He is not ordinarily required to enter manholes except in the case of transformer installations or other unusual construction. If he believes that electrical tests are necessary reasonably to substantiate the plans as turned in, he informs the assistant superintendent of

* One of a series of presentations covering the essential duties of officials of a public utility distribution department serving between 50,000 and 75,000 meters. Organization of the distribution department was outlined in ELECTRICAL WORLD, October 13, 1945, page 106.

distribution. In case of large retirements, he consults the office records if necessary to determine if all retired material has been properly reported. In the early afternoon daily he visits the stock room to check the retired material actually returned there against the retirement reports, and may also assist the stock man in deciding what material is to be junked.

He checks daily with the stock room foreman as to any cases during the previous working day when it was necessary to issue material in excess of that laid out for the job. He investigates these and is prepared to report on them to his superior. Any errors or omissions discovered in these field or stock room checks are called to the attention of the department head concerned by the inspector. If additional construction or paper work is necessary, such department head is responsible for getting it done. Minor corrections to paper work may be made by the field inspector. Plans and records found correct by the inspector are dated and initialed by him and handed to the departmental records and plans clerk. Records involving a foreign company are handed to the joint line representative before these go to the clerk just named. Normally these men are not scheduled to keep any piece of paper over one full working day.

Map and Material Checks

The inspector checks, according to his judgment, changes and additions to plate and circuit maps, and other records; material issued slips, and material returned to stores slips, before these go to the main office on a regular time schedule. He is also active in connection with estimating the cost of repairing damages to company equipment on the distribution system. He follows up the removal of jointly owned poles in cases of separation of pole occupancy, seeking to bring about the removal of old poles from their sites after the power company's circuits have been transferred from these. A monthly notification of the joint line representative is required from the field inspector of the desirability of clearing up this condition so long as the old pole continues in situ. Each new street light location is checked by the inspector, who records the date of first starting service at the particular lamp. This information goes to the superintendent's secretary for permanent record. The inspector may discuss any discrepancies with any departmental officials interested or having information, full cooperation being required all around.

Foremen in the field discovering errors or omissions of any kind make written reports on these for each job order, and these go to the department head concerned; thence to the superintendent of distribution and to the inspector. The field inspector then investigates each case, talks with the foreman if necessary, obtains information needed, and calculates the added cost of the job due to such errors or omissions including extra labor, transportation or time wasted. He enters this cost with remarks, sketches, etc., on an improvement memorandum form, signs and dates it, and discusses it with the department head under whom the work was laid out. The individual responsibility for the condition is then recorded on the form, and the reasons, if any, for the error or omission. The field inspector then turns the report over to the assistant superintendent of distribution.

IMPROVEMENT MEMORANDUM

For reporting anything that is wrong in order that improvement may be made.

Date _____

Employees are expected to report on these blanks any mistakes, omissions or wrong conditions which may come to their notice. This paper should be handed to the Dept. Head who will pass it to the Supt.'s. Office for attention. These forms should be used for all reports of a general nature for which special forms are not provided. The following are examples of matters upon which reports should be made. Improper or insufficient stock provided, mistakes in orders or special instructions, defective material or apparatus, unsafe conditions, wasted time, improper or dangerous construction, etc.

Signed _____

Noted by _____ Dept. Head

FIG. 1—Improvement memo form for recording of data and remarks

• • •

Series Circuit Tester Has Safety Fuse

WILBUR C. SEDGWICK
Superintendent Substation Maintenance
Central Illinois Light Co., Peoria, Ill.

Because of the ever-present possibility of accidental contact between 2.4-kv. distribution conductors and series street lighting circuits, special safety features have been built into the test lamp set used for locating opens in street light circuits on the Central Illinois Light Co. system. Arrangement of the test set is shown on the following page.

Usual procedure in locating an open in a series street light circuit on the Peoria system has been to disconnect the circuit at the substation, connect the deenergized circuit terminals with a jumper and apply a potential of 115 volts between circuit and ground.

Past practice has been to open the mid-point of the series circuit and connect a test lamp between the conductor and ground on both sides to determine which half was faulty. Procedure was then to move along the faulted half of the circuit, making tests at sectionalizing points until the open was found.

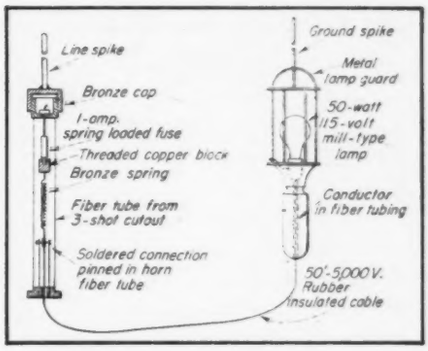
This practice, while conventional, involves a hazard to the tester if there is an accidental contact between 2.4-

kv. distribution conductors and the street light circuit. Then 2,400 volts to ground can appear across the test lamp.

The CILCO tester has been designed to provide the maximum protection to the lineman in such a contingency. The tester consists of a 50-watt, 115-volt, mill-type lamp connected in series with a 1-amp., S&C spring-loaded distribution fuse. The test lamp is in a conventional trouble lamp socket and guard assembly to which a long metal grounding spike has been added. This metal guard and grounding spike are connected to side of the lamp socket. The center socket connection is brought out through the trouble lamp handle in a fiber tube and connected to approximately 50 ft. of 5,000-volt rubber-insulated cable that terminates in the series fuse housing and its line spike.

To use the tester the lineman pushes the spike on the lamp guard into the ground at the base of the pole and, having climbed up to the series circuit, touches the line spike on the fuse housing to the proper conductor. If the series circuit accidentally is energized at 2.4 kv., the fuse will blow immediately, expelling the cable from the fuse housing harmlessly. If the circuit is solid and unfaulted back to the substation, the test lamp in the trouble guard *on the ground* will light. Of course, if the open circuit is between the test point and the substation the lamp will not light.

It should be noted that the test lamp which might shatter under accidental over voltage is always *on the ground* while the test is in progress.



SAFETY TEST LAMP has 1-amp. distribution fuse in series with lamp to protect lineman from effects of accidental cross connection of street light and distribution circuits. Spike on lamp guard is ground connection for test. Contact with line is made with spike on fuse housing

• • •

Electrical Devices Aid Hot Water Supply

Quick heating of city water having a temperature as low as 40 deg. F. in winter, and recapturing heat in cooling water in summer and winter, are methods which provide an all-year around ample hot-water supply for domestic use in the eleven-story building where the *Newark Evening News* is published. The system was developed and installed by the engineering department of the Evening News Publishing Co., Newark, N. J. Three small circulating pumps, a float switch, a solenoid valve and three thermostatic-controlled immersion heaters aid in supplying hot water. All the devices are connected to 120-volt a.c. circuits except the three 5-kw. immersion heaters which operate from a 240-volt a.c. circuit.

During the winter season, hot water from the stoker-fired boilers is circulated continuously through a heat exchanger in a 500-gal. water storage tank. Natural circulation of the heating water from the boiler is changed to forced circulation by a centrifugal pump at times when the maximum demand for hot water occurs, such as at wash-up time about 5 p.m. The pump (Bell and Gossett Co.) has a 1½-in. pipe connection and is driven by a 1/6-hp. motor.

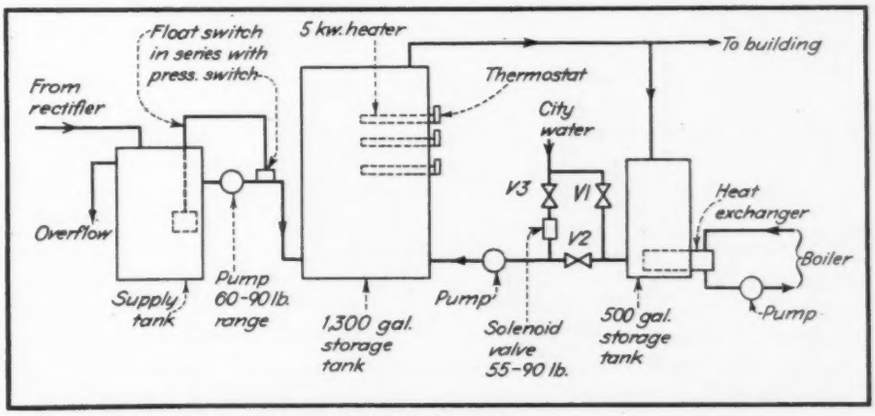
A similar centrifugal pump circulates the water between the storage tanks, thereby keeping the water temperature fairly constant. This pump functions when the temperature of the stored water drops to 145 deg. F.

City water is supplied through a 1¼-in. solenoid valve (Automatic Switch Co.) which opens when local pressure is below 55 lb. and closes when the pressure is up to 90 lb. Three hand-operated valves (normal position: V1 closed, V2 and V3 open) on the incoming supply line were installed for emergency arrangement (V1 open, V2 and V3 closed), so as to run the 500-gal. tank directly from the city water supply and isolate all other parts of the local hot-water system.

Hot-water heating costs have been reduced by shutting down the steam-heating boiler during the summer months and by utilizing the hot water discharged at 115-120 deg. F. from the heat exchangers for the mercury arc rectifiers, (ELECTRICAL WORLD, November 25, 1944, page 77) also the cooling water from high-vacuum pumps and a Freon compressor, all directed into a common supply tank.

A third centrifugal pump with a 1/6-hp. motor and a 1½-in. pipe connection is used to force water from the supply tank to a 1,300-gal. storage tank. This pump operates when system pressure is 60 lb. or less and cuts out at 90 lb. A float switch (Cutler Hammer) in series with the pressure switch (Allen Bradley) shuts down the pump on low-water level in the supply tank.

In the large storage tank three 5-kw. immersion heaters (Westinghouse) were installed to help maintain a water temperature of approximately 150 deg. F., particularly when the draw-off is excessive at the end of a work shift.



INSTALLATION OF ELECTRICAL DEVICES improve domestic hot-water supply in eleven-story building of newspaper publisher. Arrows indicate direction of water flow

Principle of Automatic Shielded Arc Welding

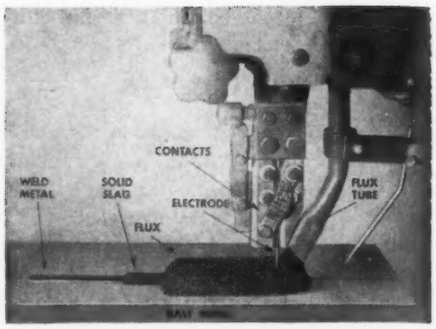
R. H. DAVIES,
Consulting Engineer,
The Lincoln Electric Co., Cleveland, Ohio

A recently devised process of automatic shielded metallic electric arc welding presents new concepts in the field of welding engineering. It is the development of a method of feeding the bare electrode into a quantity of flux deposited automatically ahead of the arc.

In this process, known as "Lincolnweld," granular flux is deposited on the joint to be welded, deep enough to cover the completed weld. Bare metallic welding electrode is power-fed into the blanket of flux, its rate of feed controlled automatically for proper arc length. Elements of the process are shown in the illustration.

Direct current, supplied by a motor-generator welder, produces the arc for the welding. The flux adjacent to the arc melts, floats on the surface of the molten metal, then solidifies as a slag on top of the weld. Since the arc and molten metal are blanketed by flux at all times, the weld metal is completely protected from contact with the air, assuring maximum quality of welds and making possible the use of extremely high amperage for faster welding and lower costs. Approximately one pound of flux is consumed for each pound of deposited metal. Unfused flux can be reclaimed for further use.

Large current densities are used, as high as 650 amp. with $\frac{1}{8}$-in. electrode. Thus greater penetration and smaller cross-sections of weld metal result. This gives less warpage and distortion. The process is simplified by using one grade of flux and one electrode analysis for a wide range of steel analyses. Attachments are provided for butt, lap and fillet welds.



ELEMENTS of automatic metallic shielded electric arc method using butt welding operation as example

With this automatic shielded electric arc method a butt joint of $\frac{3}{8}$-in. plate can be welded at a speed of 32 in. per min. (see table). By manual welding, $\frac{3}{8}$ in. is the thickest plate which can be joined with full penetration using present practice, two passes; that is, welding from one side and then the other side with the work in flat position, also employing $\frac{5}{16}$-in. diameter electrodes and 450 amp. with an arc speed of 18 in. per min., or a speed of 9 in. per min. for the joint, assuming that the arc is working 100 percent of the time.

Due to the higher currents possible, $\frac{3}{4}$-in. plate can be completely fused by this automatic method, using two passes at approximately 900 amp. with a speed of 11 in. per min. The speed to make this joint manually using good practice would be 1.9 to 2 in. per min. It is recommended that $\frac{3}{4}$-in. be taken as the upper limit of thickness for square edge butt welds automatically arc welded since build-up becomes excessive when the higher currents are used for the thicker material.

Specifications for Automatic Metallic Arc Butt Welding of Plate of Various Thicknesses

PLATE THICKNESS, IN.	Pass	Amp.	Volts	Speed, in. per min. per pass	Wire Size, in.
1/4*	1	475	29	48	5/32
	2	575	32		
3/8	1	500	33	32	7/32
	2	850	35		
1/2	1	700	35	27	7/32
	2	950	36		
5/8	1	800	35	24	7/32
	2	950	36		
3/4	1	900	36	22	7/32
	2	950	36		

* Must be down flat on platen.
NOTE: Seams must be butted tight. Seal all gaps on ½ in. or thicker with a fast seal bead on the second pass side. Seal 3/16 in. and less on the first pass side.

• • •

Transformer Mounts on Ground Sites

Regulations for mounting transformers on the ground (including rebuilding old installations) have been prepared by an eastern electric utility to insure thorough attention to details. Foundation is of 2-in. creosoted wooden planks, transformers being set on short sections of manhole roof rails laid on the foundation except where similar supports are permanently attached to the cases. Rails are cut to length and given two coats of black asphaltum paint before being taken into the field. In wet or soft ground old railroad ties may be used instead of plank. Above 50-kva. rating, transformers may be installed on reinforced concrete; also, if appearance is very important. Foundation designs are a duty of the engineering department, with full design checking by the safety supervisor.

Ground installations are required to be protected by substantial wooden fencing at least 5 ft. high, with gate, hasp and standard padlock. Fencing must clear transformers by at least 18 in. horizontal distance. Posts are to be of old poles or timbers at least 4 in. x 6 in. in section, with brush-treated creosoted butts to 6 in. above ground. Minimum size of horizontal members of fence frames is 2 in. x 4 in. Fence and gate are covered by $\frac{7}{8}$-in. matched boards not over 5 in. wide and set

"THE HANDIEST TESTING INSTRUMENT WE'VE EVER HAD"

say hundreds of users

MEASURES BOTH

VOLTS AND AMPERES

(ACCURACY 3%)

G-E HOOK-ON VOLT-AMMETER

You get double value from this handy, portable, a-c instrument. It will measure up to 600 volts and up to 600 amps. Just hook it around the conductor, push to close the gap, and read the current. Leads are provided for voltage measurements. Booklet GEA-2950 gives complete details, prices, and many helpful suggestions for operating this versatile instrument. Ask your G-E representative or write General Electric Company, Schenectady 5, New York.

HEADQUARTERS FOR MEASUREMENT

GENERAL ELECTRIC

602-94-6200

tight. Cover boards must reach the ground. The top of the enclosure must be covered by a wooden grating of boards at least $\frac{1}{8}$ in. x 2 in., with openings small enough to prevent passage of a standard baseball. The gate is located so that primary fuse cutouts are easily accessible without reaching over or around transformers. Installations at the feet of poles have fencing to include not over half the pole, leaving the clear side free for climbing. Corner posts are set by the line construction force, the rest of the fence being built by company carpenters and painted two coats of green. At least one danger sign is attached on the gate side of the fence. Temporary fencing is required where transformers are made alive before the permanent fence is built, on responsibility of the foreman ordering transformers to be placed in operation. On approval of the superintendent of distribution, transformers conspicuously located and where appearance is of much weight may be fenced in with wire attached to metal posts, provided the site is not readily accessible to children.

Where more than one transformer is set, primary and secondary connections are run in fiber or metal conduit, the latter when used being grounded to cable sheaths. Cutouts and conduit are required to be supported by substantial treated lumber separate from the fence. This may be brush treated with creosote, or standard treated crossarm stock may be used. When such installations are fed from the underground system, primary fuse cutouts are located within the inclosure. When fed from overhead, primary fuse cutouts are required to be mounted on crossarms and rubber-covered wires brought down the pole in fiber conduit to the transformers. If desired, secondary wires may be carried up the pole in fiber conduit. Vertical fiber conduit ends just below horizontal fiber conduit used to carry transformer connections, all wires being drip-looped in passing from one conduit to another. If lead cable sheaths are not available for grounding all transformer cases, a standard ground rod is driven within the inclosure.

• • •

Coal Pulverizer Balls Sorted Mechanically

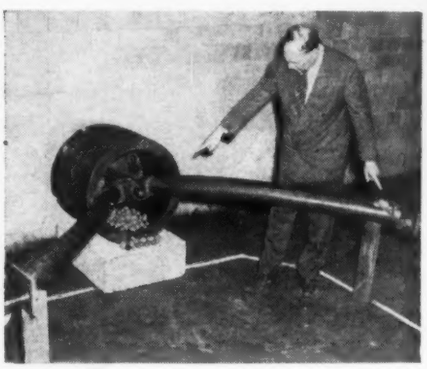
A device for classifying steel coal-pulverizing balls, developed by George Spangler, chief engineer, Harding Street Plant of the Indianapolis Power & Light Co., makes it possible to sort over 18 tons of balls and remove those under $\frac{3}{4}$-in. diameter in a matter of an hour. Formerly this job required the manual effort of a crew of six men four days.

The classifier shown, which has been in use since May, 1945, consists essentially of an enclosed squirrel cage enclosed within and bolted to the drum of a coal pulverizer and revolving with it. Balls are scooped up and led into the squirrel cage by two feeder pipes that also are bolted to the mill drum and turn with it. Bars of the squirrel cage are spaced so that balls $\frac{3}{4}$ in. and smaller in diameter will fall through and be expelled from the drum through the coal inlet. During classification the pulverizer drum is run backwards. Thus the spiral conveyor which normally draws coal into the pulverizer can be used to expel the small balls that drop through the squirrel cage.

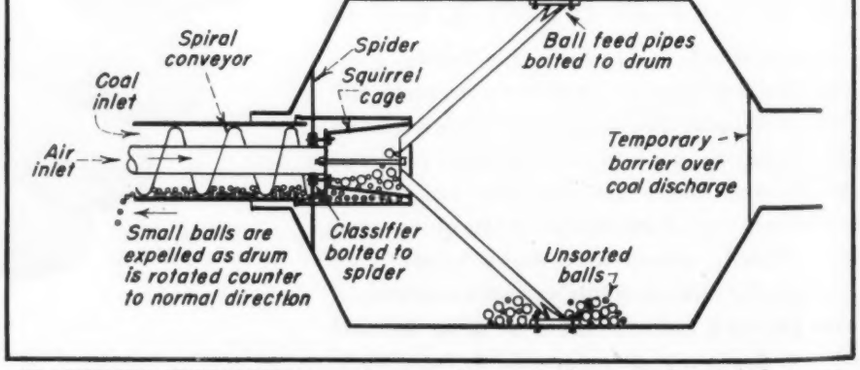
Each of the two Foster Wheeler ball mills supplying powdered coal to the newest Harding Street boiler operates with 18 tons of pulverizing balls. These balls start out new with a 2-in. diameter but are constantly being worn down. New balls must be added daily. After about six months the proportion of small balls becomes too great and they must be removed and an equal weight of new balls added.

Before the classifying device was developed, the job of sorting out the small balls was a substantial operation. It was necessary to dump the entire 18 tons of steel balls out of the pulverizer and shovel them by hand over a screen that would pass the $\frac{3}{4}$-in. balls. This operation usually required a six-man crew for about four days. And when finished it was still necessary to return the 18 tons of new and used balls to the mill.

Now, however, it is only necessary to stop the mill, install the classifier and run the drum in reverse. The small balls will roll out of the open end of the coal inlet conveyor where they drop into a barrow and are wheeled away. In the course of an hour the entire two or three tons of small balls will be completely sorted out.



MECHANICAL BALL CLASSIFIER, when bolted inside coal pulverizer drum and turning with it, sorts 18 tons of balls and expels the undersized ones. Balls picked up by the extended tubes roll into squirrel cage in central cylinder. Small ones drop between bars and are expelled



CLASSIFIER INSTALLED in pulverizer drum, as shown in this sketch, turns with the drum. Balls scooped up by feed pipes are led into classifier. Small ones drop through bars of squirrel cage and are expelled by spiral coal inlet conveyor as mill turns backward. New balls are 2 in. in diameter

These G-E tank-construction features keep maintenance costs low

1. Conveniently located filter press connections and oil sampling valve enable easy testing and conditioning of oil.
2. Welds which hold liquid are made externally for accessibility.
3. Tubes are braced against vibration.
4. Glyptal paint, applied over clean, shot-blasted surface inhibits corrosion.
5. Tubes are sturdy, swaged at ends to increase thickness at point of welding, and to reduce strains.
6. Tank is open-hearth steel, checked for carbon content to insure good welding qualities.
7. Properly compressed synthetic rubber gaskets or non-porous welds seal all tank joints.
8. Tube and header construction contributes to oil tightness by radically reducing the number of openings in the tank wall.

The tank is an integral part of a G-E transformer. Strength, shape of housing, liquid tightness, resistance to weather have all been considered. The result is a tank that is **durable;** that requires only a **minimum** of maintenance throughout the life of the transformer.

esting of welds, the use of synthetic rubber gaskets, uniform ow-painting—all are major factors in the construction of -E tanks.

This detailed forethought in the design of the tank typifies e design of every element of a G-E transformer. First-hand perience with field maintenance conditions, an outstanding owledge of electrical design, and testing with the most up- -date facilities have anticipated every feature that will cut rvice costs and keep your transformer in continuous, efficient peration.

If you are in the process of selecting a transformer, look r these features that will result in tangible savings in instal- tion and maintenance costs. For information call your nearest -E representative, or write to *Apparatus Dept., General ectric Company, Schenectady 5, N. Y.*

POWER TRANSFORMERS

GENERAL ELECTRIC

401-32-5155

How to Kill Weeds and Sterilize Soil

Proper use of herbicides is one of the most satisfactory ways to solve the problem of weeds and miscellaneous vegetation that grow up around poles, other structures and along right-of-ways of electrical lines. Accompanying information on five items for weed suppression has been supplied by a division of the United States Department of Agriculture.

M. A. McCALL, Assistant Chief of Bureau, and L. W. KEPHART, Senior Agronomist,
Bureau of Plant Industry, Soils and Agricultural Engineering,
Beltsville, Md.

SODIUM ARSENITE

Usage . . . Most widely used chemical weed killer because of its quick and complete action on most plants. Usually best for miscellaneous broad-leaved weeds, such as ragweed, pigweed and dandelion. Basic ingredient of most spray preparations employed to destroy weeds in railroad tracks. In normal times, it is cheapest soil sterilant.

Disadvantages are: (1) Very poisonous character and consequent danger to livestock; (2) not too effective for destroying grasses.

Many species of grasses are tolerant to dosages of arsenic that are fatal to most broad-leaved species of plants. An area treated with an arsenical is likely to be completely free of most broad-leaved weeds, but to present within a year or so a complete sod of grass. This is particularly true on red soils or others in which there is a high content of iron.

Mixture . . . Usually applied as a spray to the foliage. Spray solution made by dissolving the chemical at rate of approximately 1 lb. per gallon of water. Much weaker solution may be employed if bulk of vegetation is of nonresistant species. For average growth 150 gal. of spray solution are sufficient to treat an acre.

For more complete sterilization of soil, practice is to apply sodium arsenite either dry or in solution directly to the soil at the rate of 3 to 4 lb. per square rod (480 to 640 lb. per acre). This results in the death of practically all plants growing in the soil at the time and the prevention of future growth, except some grasses, for from two to five years. For the purpose of treating soil around wooden poles, this would be the usual practice.

BORAX

Usage . . . In recent years, attracted a good deal of attention for soil sterilization. It is nonpoisonous, noninflammable, noncorrosive and easy to handle. Must be applied in rather heavy dosages.

Mixture . . . Applied dry to the surface of the soil at the rate of 15 to 25 lb. per square rod, with a repeat application about six months later at about half the original rate. This results in rather complete elimination of vegetation of all kinds for from two to four years. Action is much slower than that of sodium arsenite and two or three months may elapse before the soil becomes bare.

Chemical is only slowly soluble in water and the action does not take place until the chemical is dissolved into the soil by rain.

SODIUM CHLORATE

Usage . . . Widely employed for killing the more resistant kinds of weeds, such as wild morning glory, quack grass, and many shrubs. More costly than either sodium arsenite or borax.

Has serious disadvantage of producing a dangerous fire hazard when in the presence of dry organic matter. For this reason, it is not a good material to use around wooden poles.

Mixture . . . Scattered in dry form on the surface of the ground, an application of 3 to 5 lb. per square rod kills virtually all existing plants. Soil remains bare and sterile for 18 or 24 months, but the sterility disappears as soon as all of the very soluble salt has leached out of the upper soil.

OIL

Usage . . . In areas contiguous to oil fields, various kinds of cheap oils may be used to sterilize soil. Its use is likely to introduce a fire hazard, but sterility produced by oils is practcially permanent.

Mixture . . . Quantity required to produce permanent sterility is from 5 to 25 gal. per square rod.

COMMON SALT

Usage . . . In areas where salt can be obtained cheaply its use is not a bad practice.

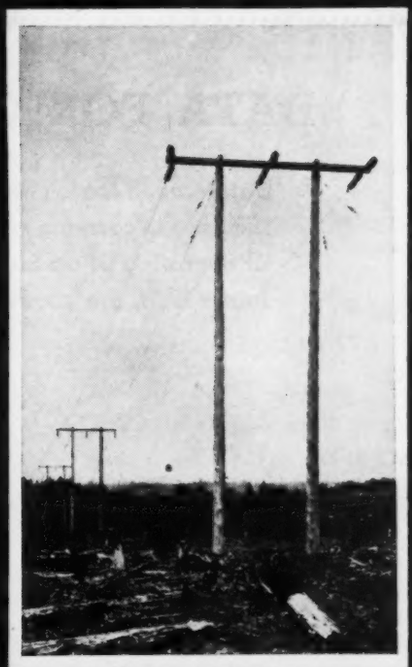
Mixture . . . Applied at the rate of about 1 lb. per sq. ft., will sterilize most soils for 15 years or more.

TIME WHEN YOU *KNOW*

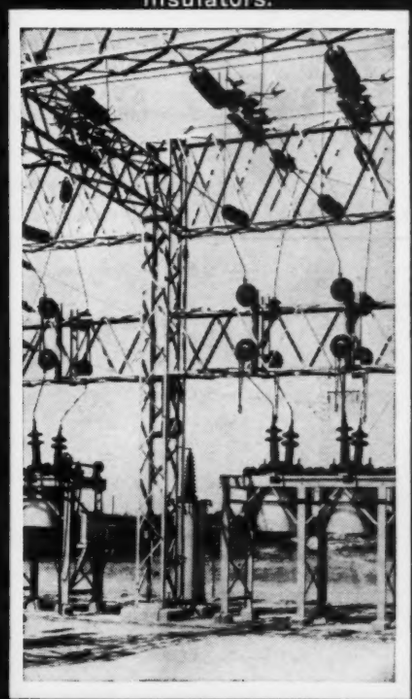
IT IS...

Years ago, when it lay in a show case, this old carving knife looked like any other. Its buyer probably asked, "How good is it". Time and use have long since answered that question. In the purchase and use of an insulator, exactly the same thing is true. There finally comes a time when you forget the question, "How good is it?". You *know!*...The important thing--the distinctive thing--in any O-B insulator; a suspension unit, a pintype, a station insulator, a bushing; a piece of hardware, is this: many years after installation and hard service, it will still meet every requirement for which it was originally purchased. The pictures on this page are a small part of the proof of this statement...When you insulate with O-B, the time will finally come when you forget the question "How good is it?". You *know!*

2649-H



Back in 1923 this picture was taken after construction of this 110-Kv. line. A similar picture today, 23 years later, would show the same O-B suspension insulators.



The O-B switch and bus insulators on this station are finishing out their 18th year without requiring attention.

DATA FOR CAPACITOR APPLICATIONS

Formulas in conjunction with tabular data aid determination of voltage rise, increase in carrying capacity, and reduction in annual losses; the advantage of operating at an improved power factor, based on 100-amp., 0.95 power factor load, are shown in data made available by Cornell-Dubilier Electric Corp., South Plainfield, N. J.

FORMULAS

1. Volts Rise Due to Capacitor, (3-phase circuit)
The application of a shunt capacitor will cause a voltage rise that is equal to:

$$V_r = \frac{\text{KVAR}_c \times X}{\text{KV}}$$

where

V_r = volts rise
X = reactance of one conductor from substation or generator to capacitor = ohms reactance per unit length multiplied by length
KV = kilovolts before capacitors are connected
KVAR_c = capacitor KVAR

2. Approximate Percent Rise in Voltage in a Transformer Due to a Shunt Capacitor on the Load Side:

$$\text{Percent Rise} = \frac{\text{KVAR}_c \times X}{\text{KVA}}$$

where

KVAR_c = capacitor KVAR
KVA = transformer KVA
X = percent reactance of transformer

3. The Increase in KW Carrying Capacity of 3-phase Line Released by a Shunt Capacity Is:

$$\Delta \text{KW} = \frac{\text{KVAR}_c}{\tan\theta_1 + R/X}$$

where

X = total reactance from substation or generator to capacitor
R = total resistance from substation or generator to capacitor
θ_1 = original power factor angle
ΔKW = increase in capacity released by capacitor
KVAR_c = capacitor KVAR

4. Annual Kilowatt-Hour Reduction in Losses on a 3-Phase Circuit Due to Power Factor Improvement Is:

$$\text{KW-HR Reduction} = \frac{R \times \text{KVAR}_c\,(2\,\text{KVA}\sin\theta_1 - \text{KVAR}_c)\,8760}{1000\,\text{KV}_1}$$

where

R = resistance in ohms of one conductor to the load center
KVAR_c = 3-phase capacitor KVAR
KVA = load kilovolt-amperes
KV = line kilovolts
θ_1 = original power factor angle

THE EFFECT OF IMPROVING POWER FACTOR ON A 3-PHASE CIRCUIT IN CONDUIT

Tabulation based on load of 75.5 kw., 460 volts or 37.75 kw., 230 volts

Power Factor, %	Current in amperes or %	Conductor size needed to carry load, AWG or Mcm.	Weight (lb.) of copper per 100 ft.	Comparative Transformer size in % to carry the load	Total Volts Drop per 100 ft. of Circuit length	Watts Loss per 100 ft. of Circuit length	Total Volts Drop per 100 ft. of circuit length with 1/0 wire used throughout	Watts Loss per 100 ft. of circuit length with only 1/0 wire used throughout	% Increase possible in kw. load, with same amperage and wire size, as shown in Columns B and C respectively, but with power factor improved to 95%
A	B	C	D	E	F	G	H*	J*	K
100	95	1/0	96	95	1.91	279	1.91	279	—
95	100	1/0	96	100	2.03	310	2.03	310	0
90	106.5	1/0	96	106.5	2.12	350	2.12	350	6.5
85	113	2/0	120	113	1.85	315	2.24	394	13
80	120	2/0	120	120	1.95	354	2.29	445	20
70	137	3/0	152	137	1.80	366	2.50	580	37
60	160	4/0	192	160	1.76	396	2.72	790	60
50	192	300	281	192	1.73	393	3.00	1145	92
40	240	500	464	240	1.81	345	3.50	1760	140

**Columns H and J show part of the cumulatively harmful effect the overloading of wire has on its voltage drop and losses. Harmful changes in wire characteristics due to temperature rise under these overloads were not taken into consideration in this table.*

AVOID DANGEROUS "SINGLE PHASING" BY USING KYLE AUTOMATIC THREE PHASE OIL CIRCUIT RECLOSERS

Only KYLE gives you Dual Operating Characteristics

Exclusive KYLE dual operating characteristics give:

1. **Fast opening on first and second** operations. This permits the automatic clearing of temporary faults without damage to sectionalizing fuses.

2. **Time delay on third and fourth** operations. This allows the affected fuse to blow, isolating the permanent fault, keeping main lines in service.

After the sectionalizing fuse blows, the Kyle Recloser resets itself for another cycle of operations.

● Many a burned-out motor results from even a short period of "single phasing" when a permanent fault develops on one phase of a three phase system:

Kyle Type "3H" Automatic Oil Circuit Reclosers eliminate this danger. A permanent fault on any one phase will cause the Kyle Recloser to lock out automatically and disconnect service on both the other phases immediately.

Kyle Reclosers perform this vital function with the important additional feature of coordinating with fuse links to keep as great a portion of your lines as possible in service all the time.

For complete information on the protection for three phase lines afforded by Kyle Type "3H" Reclosers see your Line Material Representative.

MADE BY KYLE CORPORATION SOUTH MILWAUKEE WISCONSIN

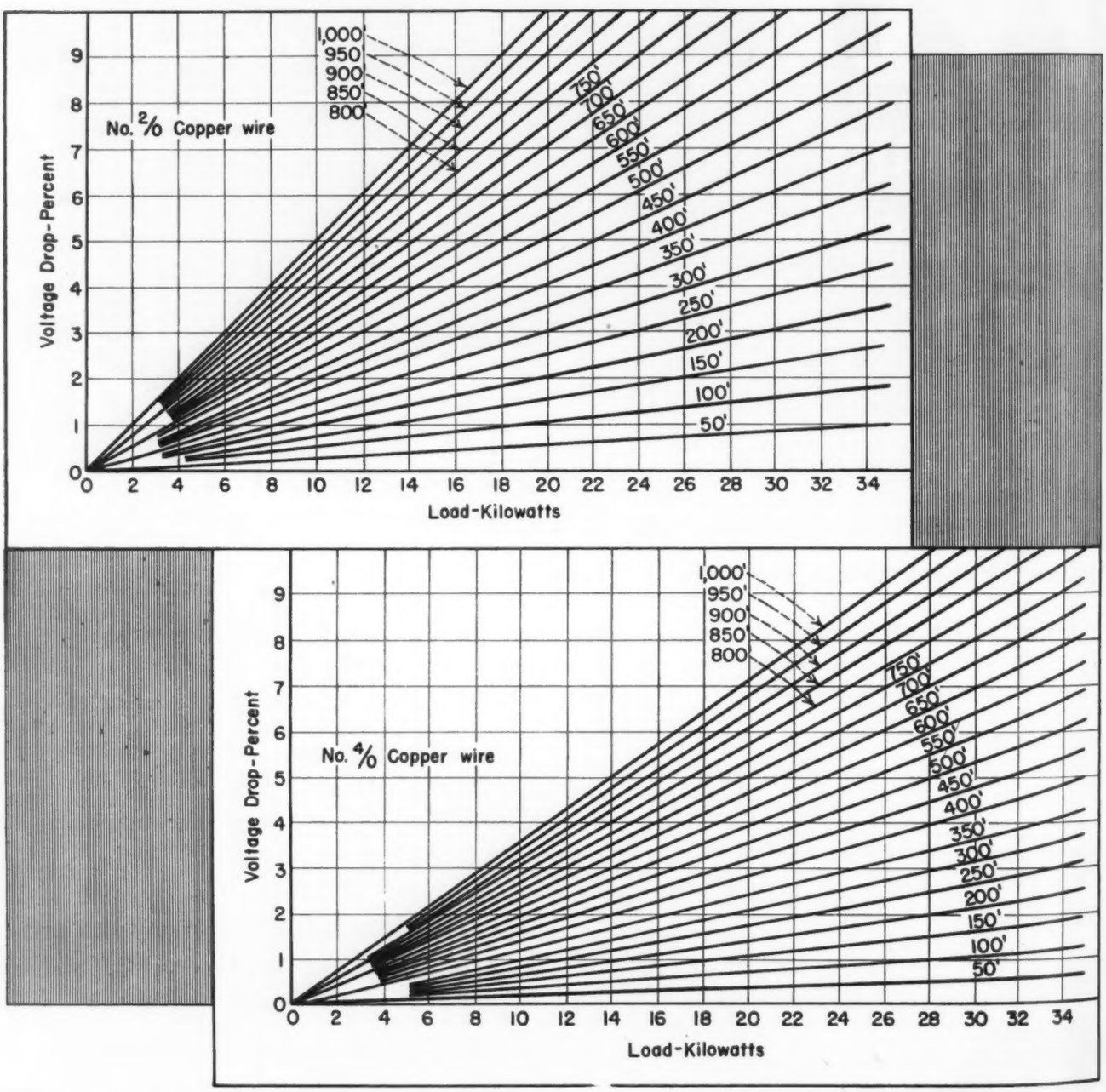
KYLE Circuit Reclosers are Designed and Manufactured for LINE MATERIAL COMPANY MILWAUKEE WISCONSIN

Voltage Drop on Secondary Circuits With Unbalanced Condition—III*

(No. 2/0 and No. 4/0 Bare Copper)

Curves give percent voltage drop for loads up to 35 kw. and for distances up to 1,000 ft. Circuit characteristics are: Bare solid copper conductors as indicated, 230 volts, 95 percent power factor, 15 percent unbalance, single-phase, 8-in. spacing.

PAGE W. CHOATE, Senior Engineer, Carolina Power & Light Co., Southern Pines, N. C.



*Concludes series. Similar curves for No. 6 and No. 4 conductors were published in ELECTRICAL WORLD, April 13, 1946, page 158; curves for No. 2 and No. 1/0 conductors in April 27, 1946, issue, page 88.

MELMAC PLASTIC 592 brush holder bushings, washers, speed regulators, and speed regulator brush holders (left to right) are now being used on all new Class 2000 National Cash Register machine motors, and are also being used for replacements on breakdowns in the field.

MELMAC PLASTIC INSULATION REDUCES MAINTENANCE ON NATIONAL CASH REGISTER MACHINES

Costly repairs and involved service charges for replacements are being eliminated by the installation of MELMAC* plastic 592 insulation parts in the motors of National Cash Register machines. Rigorous tests show that MELMAC parts operate more dependably than those made of the general-purpose plastic formerly used because of MELMAC's high arc resistance and excellent insulating properties.

Comparative tests of the two materials in rotating parts such as speed regulators and speed regulator brush holders were made under actual working conditions on Class 2000 motors.

During track resistance tests, a mixture of oil and carbon dust was smeared on the insulating parts. When the carbon brushes in the brush holders contacted speed regulators, this contamination caused arcing. The material formerly used showed an immediate track and eventually burned through. With MELMAC, contamination burned off, leaving an excellent insulating surface. Brush holders of the former material burned out and had to be replaced at 24, 35, 106, 250, 335, and 1173 hour intervals. Speed regulator insulators had to be replaced at 250 and 772 hours. All MELMAC parts were still functioning as insulators at the termination of 1423 hours.

If such exceptional arc resistance and dielectric strength in an insulating material are important to you, let us give you complete details on our mineral-filled MELMAC plastic 592. **Reg. U. S. Pat. Off.*

TYPICAL PROPERTIES OF MELMAC PLASTIC 592	
Dielectric strength	430 volts/mil.
Arc resistance (ASTM)	Avge. 130 sec.
Heat resistance	300° F.

AMERICAN CYANAMID COMPANY
PLASTICS DIVISION
34 ROCKEFELLER PLAZA • NEW YORK 20, N. Y.

Cyanamid Plastics
Beetle* • Melmac* • Melurac* • Laminac* • Urac*

Projector Shoots Line Over Crossarms, Trees

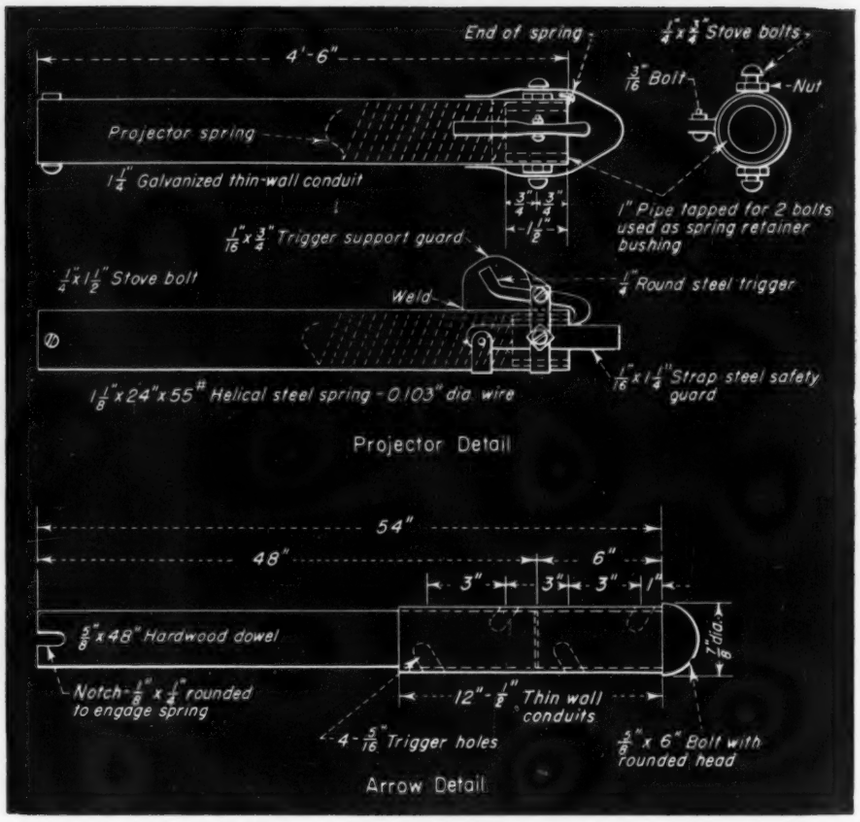
R. L. DODD
Assistant Superintendent Construction
Wisconsin Electric Power Co.
Milwaukee, Wis.

A hand-line projector that is the modern counterpart of a medieval cross bow is used by line crews of the Wisconsin Electric Power Co., Milwaukee, to shoot lines beyond the range of a thrown hand line and with greater accuracy. The idea was conceived by a line crew foreman. The projector, which shoots a 4½-ft. 20-oz. arrow with chalk line attached, has a horizontal range of 90 ft. and will clear obstacles 40 ft. in height. The light chalk line or mason cord attached to the arrow is used to pull a hand line and in turn a conductor over obstructions of various types.

Principal uses to which the projector or "bazooka" has been put to date are: (1) To shoot a line over trees, buildings or other obstructions from any position on the ground or on a pole so that wires can be pulled in; (2) to project lines from the ground over crossarms. In building rural lines the projector is used to shoot lines over the arms on newly set poles, making it possible to string wire without climbing each pole. Poles are climbed only once: to tie the wires to the insulator. Other uses of the bazooka are being found almost daily.

Line foremen report that they save the cost of the projector the first time they use it on a job.

Details of the projector and arrow are shown in the accompanying sketches. The projector was made from 4½ ft. of 1¼-in. thin-wall conduit. Propulsion force is provided by a 1⅛-in. by 24-in. 55-lb. helical steel spring made from 0.103-in. diameter wire. A simple trigger, guard and safety latch complete the device. The safety guard, a simple steel band over the muzzle of the projector, is arranged so that it can be rotated back out of the way in only one direction. This is to prevent its fouling the chalk line attached to the arrow in flight.

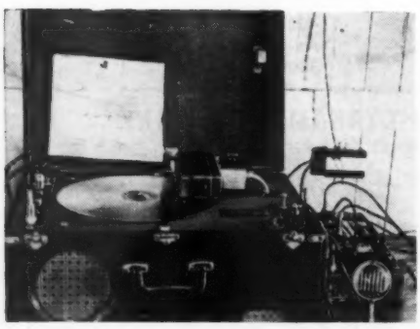


DETAIL OF PROJECTOR used to shoot light line over construction obstacles or crossarms that are beyond range of thrown handline. Light line fastened to arrow at the middle is used to pull in heavier rope for stringing wire

Arrow shot by the projector is a ⅝-in. x 48-in. hard wood dowel, sheathed over part of its length with a piece of ½-in. thin wall conduit. Nose of the arrow is weighted with a ⅝- x 6-in. bolt with rounded head.

The projector is cocked by thrusting the arrow into the muzzle of the projector against the spring. Notches in the arrow at intervals along its length engage the trigger and permit the propelling spring to be loaded to different tensions as the range requires.

• • •



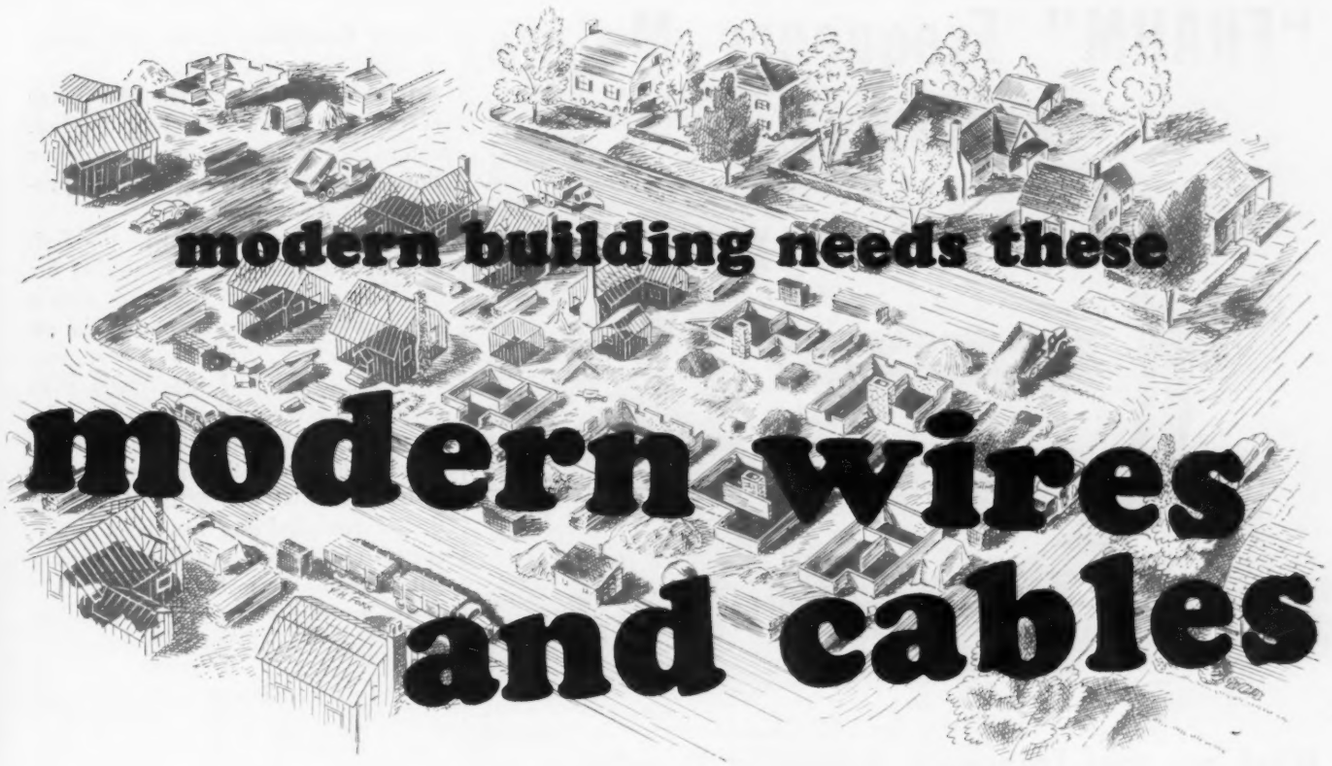
AUTOMATIC recording device records everything that is transmitted over the entire network regardless of which station does the transmitting

Two-Way Radiotelephone Has Automatic Recorder

In an area that is almost entirely swampy, one location being totally inaccessible except over water, the Union Sulphur Co., Inc., of Sulphur, La., has installed a two-way radiotelephone communications system in connection with the operation of a 100-mile pipe line which it maintains for the Reconstruction Finance Corporation, Office of Defense Plants.

The installation consists of one 250-watt FM transmitter-receiver operating at the main office, Sulphur Mines, La., with a 250-ft. tower; twelve portable 50-watt FM units; and five mobile 50-watt FM sets, for the cars and trucks. The system operates on 33,620 kc. and employs Motorola units of the Galvin Manufacturing Corp., Chicago.

The mobile units are operated by personnel who have supervision of maintenance, gas dispatching, communications and drilling of oil. Since there is no regular telephone service, the radiotelephone has proved thor-



modern building needs these modern wires and cables

PVX* *the new G-E nonmetallic sheathed cable*

FLAMENOL* *building wire—for modern wiring requirements*

Modern building requirements call for wires and cables that are capable of handling an increasing variety of electrical services. General Electric's new PVX cable and Flamenol, Types T and TW building wire, are ideally suited to meet such requirements in open or concealed work in practically any residential or commercial construction.

Both PVX cable and Flamenol building wire offer many advantages in installation and service that will "pay off" for years to come. It will pay you to check these advantages now.

PVX

PVX is a new high-quality, lightweight, small diameter cable assembly that can be installed quickly and easily, and will give long service. Insulation of the Flamenol Type T wires is a thermoplastic compound, high in dielectric and mechanical strength, and resistant to oils, acids, and alkalies. The conductors are protected with an improved crushed-paper armor, and are covered with a tough over-all braid. Both insulation and over-all braid are flame and moisture resistant. The whole assembly can be freely stripped. Available with two or three conductors in sizes 14 to 4.

Types T and TW Flamenol Building Wire

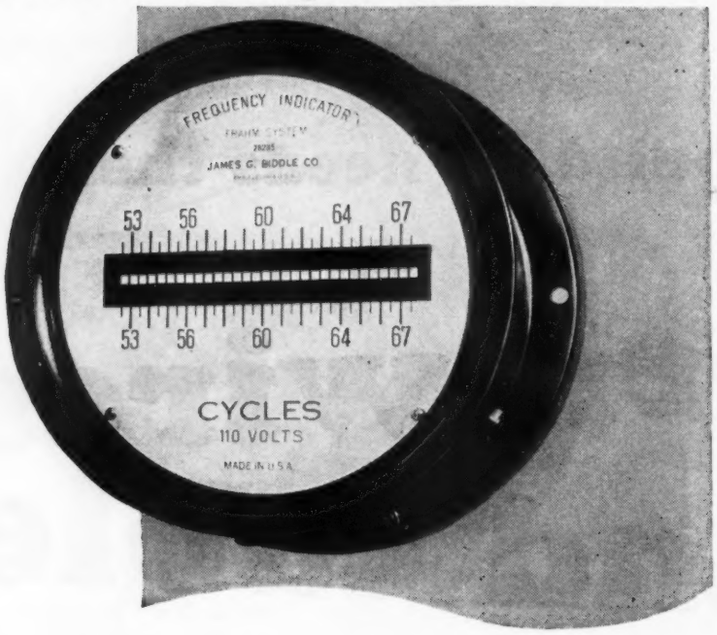
This small diameter, high-quality building wire is available in sizes No. 14 to 2,000,000 CM. It is ideal for new wiring, rewiring, and maintenance wiring. It is easy to pull in conduits, and can be stripped quickly. The insulation of both Types T and TW has long life, is high in dielectric and mechanical strength, and is resistant to oils, acids, and alkalies. Type TW is especially recommended for wiring in wet locations.

For further information, write to Section W563-9, Appliance and Merchandise Department, General Electric Company, Bridgeport, Connecticut.

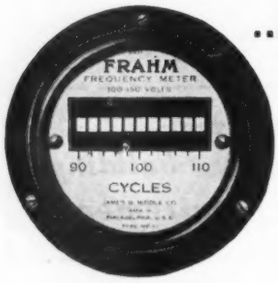
*Trade-mark Reg. U. S. Pat. Off.

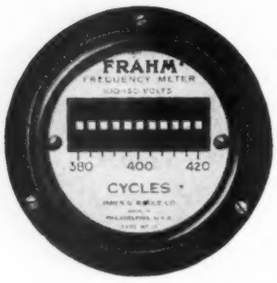
GENERAL ELECTRIC

"FRAHM" Frequency Meters



What are your Frequency Measuring Requirements ...25...60...100...400.....1400 cps?





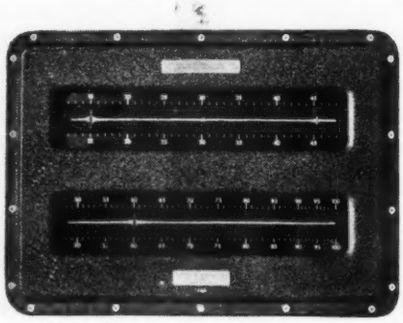
Frahm Frequency Meters in switchboard, miniature and portable types are regularly available for ranges between 15 and 500 cycles per second.

To meet special requirements, our laboratory has designed and built instruments for measuring frequencies as high as 1400 cycles. Such, we find, is possible by means of the same simple and direct resonant reed principle, usually requiring less than 0.1 volt-ampere power input, and without recourse to intermediate frequency conversion equipment. We believe that even higher frequencies are possible.

We invite correspondence regarding any frequency measurement problem in the audio and sub-audio range. For its solution we proffer our instruments, our services and facilities. In our 30 years of association with the resonant reed principle as applied to the measurement of frequency, we have been instrumental in the solution of a surprising variety of problems.

Write for Bulletin 1770-W

This instrument was developed for direct indication of frequencies in the lower audio range and for simultaneous direct indication of harmonic components. Called a Harmonic Analyzer, it has unusual electrical characteristics and a wide range, with a total of 288 reeds.



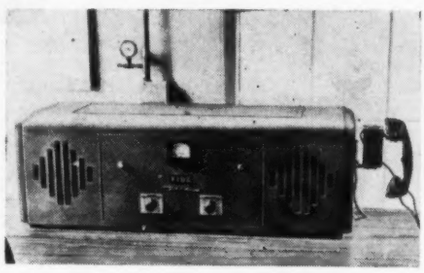
JAMES G. BIDDLE CO. 1316 ARCH STREET PHILADELPHIA 7, PA.

oughly dependable as the sole means of direct communication.

In some of the locations, the power is furnished by a public electric utility, and in other places, remote from power lines, gasoline-driven generators provide the primary power.

Permission was granted by the Federal Communications Commission for the company to start operation with a single radio operator who holds the required licenses. And the government agency also allowed the company to keep the necessary station logs by means of an automatic recorder device, which is located at the main station. It is believed that this is the first time that a recorded log has been maintained, eliminating troublesome filling out of forms, records, etc.

An average of over 200 calls has been placed over this system daily.



TWO-WAY FM radiotelephone unit in a pumping station. Connection to antenna is through a coaxial cable of copper which is kept filled with a dehydrating gas under pressure. Cable and its terminal gage are in background along the wall

•

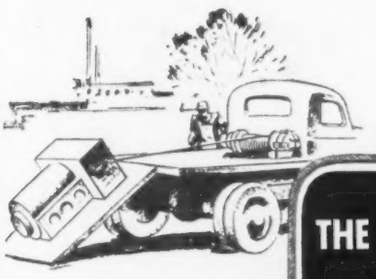
Hand Tool for Bending Small Tubing and Cable

A recently developed hand-bending tool permits various kinds of small tubing to be curved to any desired angle. This device was designed by Carroll E. Adreon, an employee of the Glenn L. Martin Co., Baltimore, Md. Utilizing the same principle, tools may be made for bending tubes of any size.

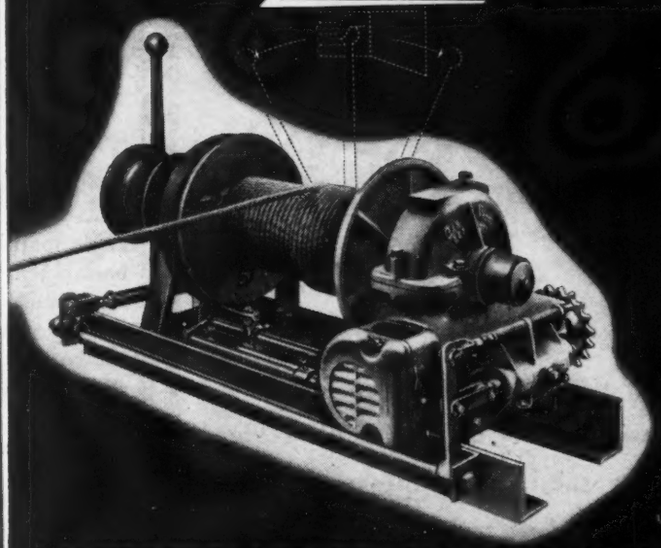
The new tool (see illustration) consists of (1) a sturdy steel base which may be used in a vise or clamped onto a bench; (2) a revolving radius rod equipped with a handle for turning; (3) a stop block grooved to hold the tubing; and (4) a movable radius block which guides the tubing around a bend roll centered on top of the base. This grooved roll has a top plate

GAR WOOD *Presents*

THE WORLD'S MOST MODERN WINCHES

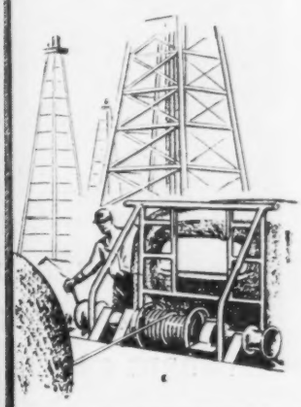


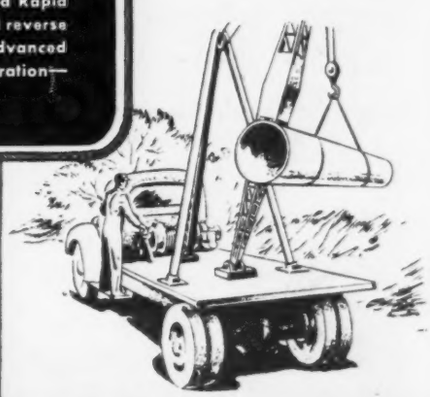
THE NEW *RAPID REVERSE* WINCH



Radically different and vastly improved, the new Gar Wood Rapid Reverse Winches incorporate the exclusive Gar Wood integral reverse gear mechanism and single lever control—plus many other advanced features. Designed and built by Gar Wood for trouble free operation—

Where Ever Industry Needs A Lift.



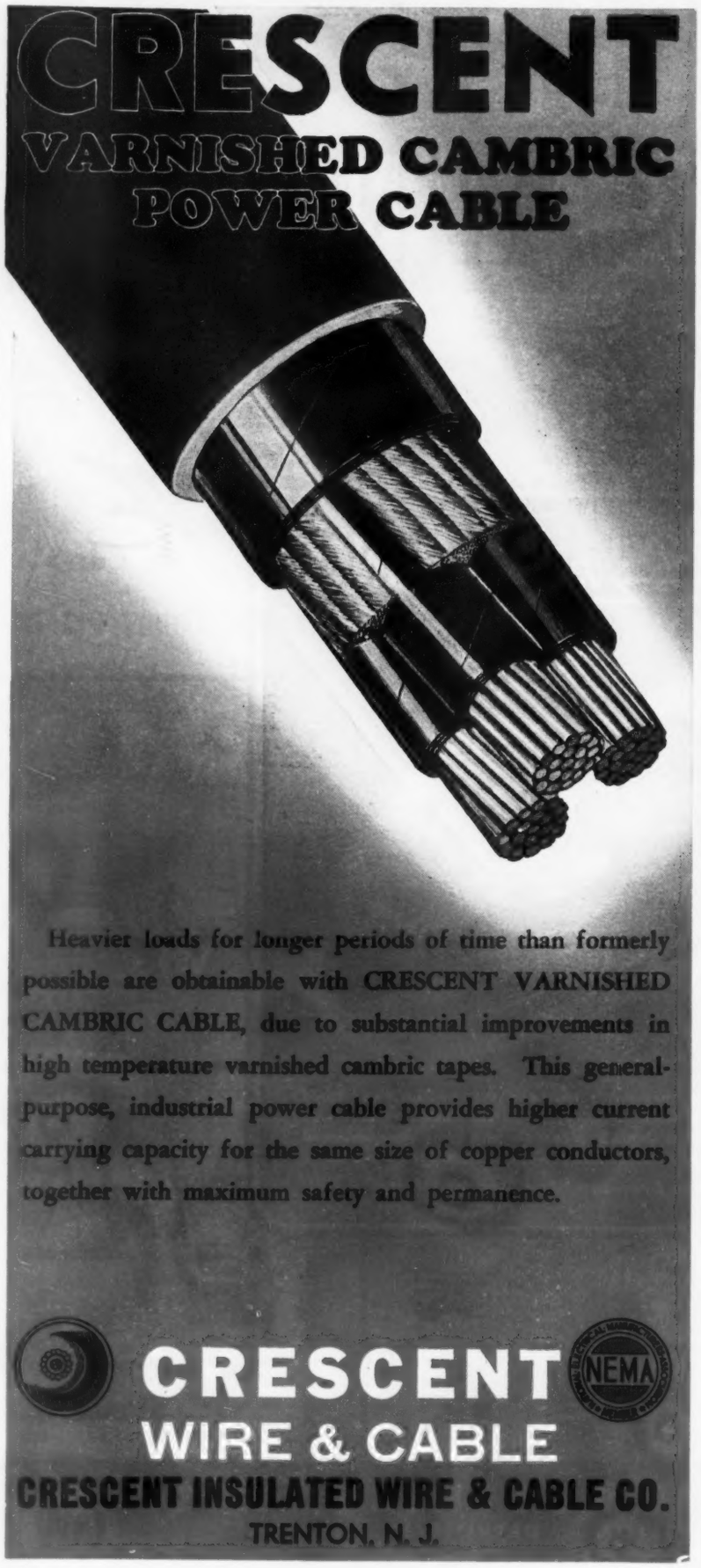


GAR WOOD INDUSTRIES, INC.

WINCH AND CRANE DIVISION DETROIT 11, MICHIGAN

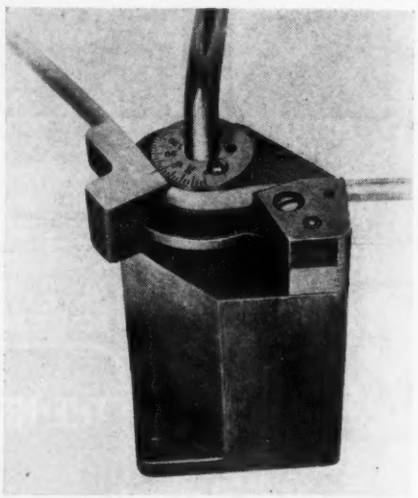
WORLD'S LARGEST MANUFACTURERS OF TRUCK AND TRAILER EQUIPMENT

OTHER PRODUCTS: Hoists • Bodies • Tanks • Road Machinery • Heating Equipment • Boats


CRESCENT
VARNISHED CAMBRIC
POWER CABLE
Heavier loads for longer periods of time than formerly possible are obtainable with CRESCENT VARNISHED CAMBRIC CABLE, due to substantial improvements in high temperature varnished cambric tapes. This general-purpose, industrial power cable provides higher current carrying capacity for the same size of copper conductors, together with maximum safety and permanence.
CRESCENT
NEMA
WIRE & CABLE
CRESCENT INSULATED WIRE & CABLE CO.
TRENTON, N. J.

scribed in 360 deg. A measuring point is marked on the movable radius block. The radius and holding blocks and the roll are so grooved as to prevent crushing or change in section of the tubing.

Allowances can be made for tubing having a "spring back" characteristic



HAND-BENDING TOOL for small tubing, also for hot-dipped or tinned spiral cable

by merely moving the measuring point to as many degrees beyond the desired angle marking as the tube will spring back when released. An operator can easily measure this amount of allowance needed from the spring back shown on the top plate of the bend roll, when pressure on the handle is released.

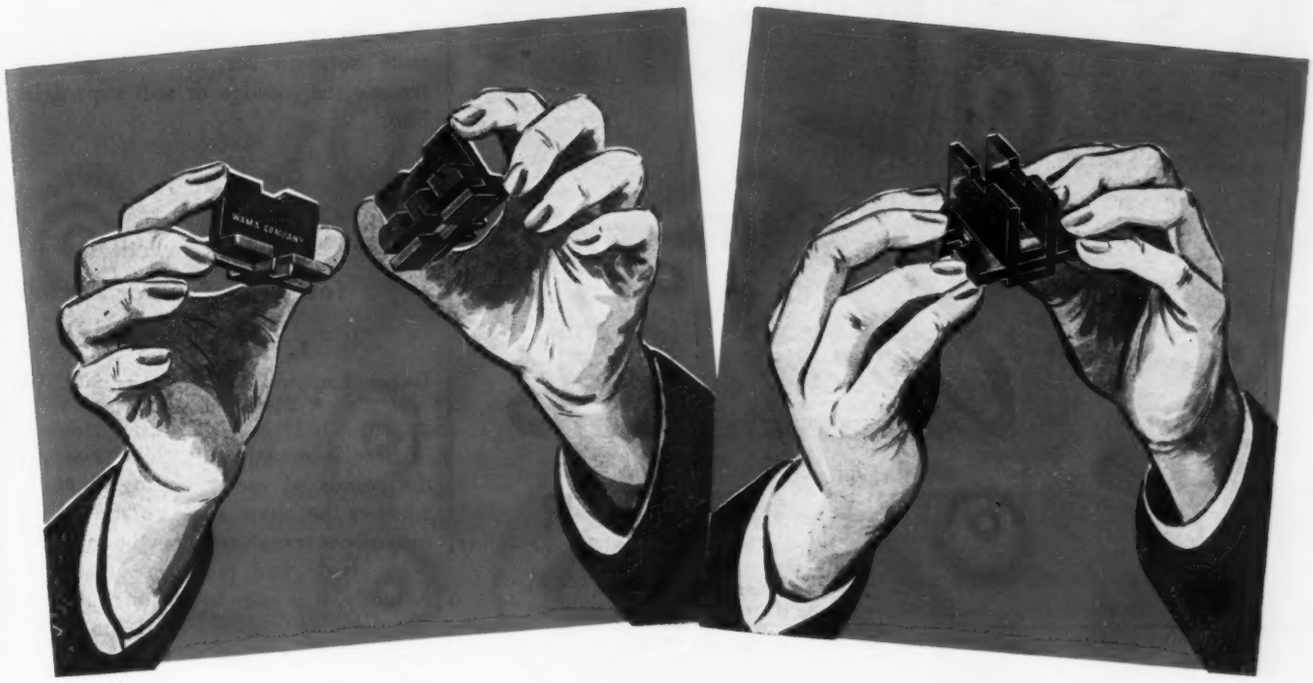
By the simple substitution of a set of phenol fiber blocks, similar in design to the metal blocks, hot-dipped or tinned spiral electrical cables (for example, battery cables) also can be bent in the new tool. Use of the phenol fiber accessories prevents the semi-molten coating on the wire from adhering to the blocks, as would be the case with use of the steel blocks on the original tool.

•

Bath to Electrobrighten Aluminum-Silicon Alloys

A solution consisting of three ingredients has been proportioned for the electropolishing and brightening process of aluminum-silicon alloys, according to M. Tosterud in U. S. Patent 2,375,394. In this process, outlined by *Glycerine Facts,* aluminum castings

As Simple as a Tinker-Toy!
As Practical as a Headlight!



ADD-A-POINT *Terminal Blocks*

PATENT APPLIED FOR

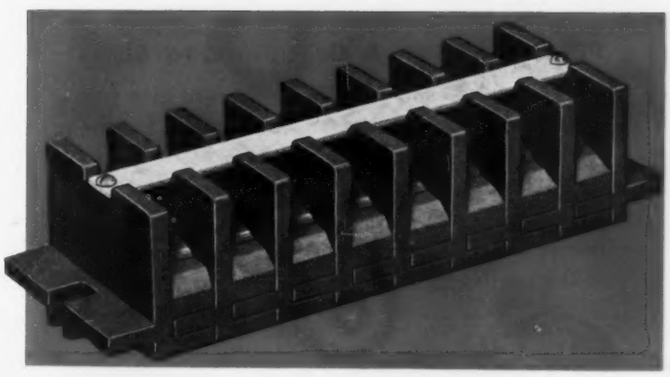
For years, electrical engineers accepted the fact that adding one terminal point to a block required the addition of *more than one* point!

Inspired by the simple Tinker-Toy of his youngster, our designer changed all that . . .

We have created ADD-A-POINT Terminal Blocks, interlocking units that may be added to the block in any number, at any time.

ADD-A-POINT Terminal Blocks are rated up to 60 amperes. They may be operated up to 750 volts, and test voltage in excess of this may be successfully applied.

For further details, as well as a sample set, just address a line to . . .



There is no assembly problem, no kit required, no through bolts, long screws or individual barriers.

WAMA COMPANY

INDUSTRIAL BUILDING • BALTIMORE 2, MARYLAND

Direct Factory Representatives in Principal Cities

SMITHway

Permaglas

GLASS-FUSED-TO-STEEL

TRADE MARK REG. U.S. PAT. OFF.

WATER HEATER

All the research, the water tests, the engineering skill, that are a part of the *Permaglas* Water Heater are there for one purpose only—to deliver sparkling clean hot water as pure as the source itself!

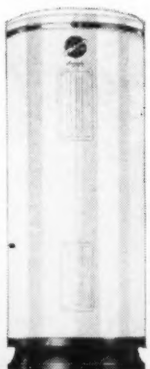
There's Only ONE *Permaglas*

SMITHway Water Heaters are lined with *Permaglas*—the sparkling blue, mirror-smooth glass-fused-to-steel. *Permaglas* CANNOT rust or corrode under *any* water condition.

Get the whole *Permaglas* story! Send today for "The Inside Story of Permaglas."

PERMAGLAS... A Great Aid to Sales

SMITHway *Permaglas* Water Heaters give you the most powerful new sales story in the home-appliance business—hot water "packaged in glass," beauty of appearance, and five other SMITHway features, all great aids in selling...



HOT WATER BY wire

A.O. SMITH Corporation

NEW YORK 17 • PITTSBURGH 19 • CHICAGO 4 • TULSA 3 • HOUSTON 2 • DALLAS 1
LOS ANGELES 54 • SEATTLE 1 • INTERNATIONAL DIVISION: MILWAUKEE 1
In Canada: JOHN INGLIS CO., LIMITED

SMITHway Permaglas GLASS-FUSED-TO-STEEL ELECTRIC WATER HEATERS

containing 5 percent silicon are brightened by anodizing for 10 min. in an electrolyte consisting of:

	Percent
Hydrofluoric acid	13.0
Glycerine	52.0
Water	35.0

A current density of 1.5 amp. per sq. in. is maintained, at a temperature of 77 deg. F. The casting is removed from the bath, washed with water, and then immersed in a potassium dichromate solution for about 1 min. to remove the smudge or soft superficial film.

•

Meter Readings Corrected for Transformer Errors

L. M. STOAKES
Design Engineer, Allis-Chalmers Mfg. Co.
Pittsburgh, Pa.

There is occasionally uncertainty in the minds of meter engineers as to whether the phase angle correction for instrument transformers is the same for both single and polyphase metering. Actually, it is easy to demonstrate that the same expression $\cos\theta/\cos(\theta\text{-}B)$ applies in both cases, if there is reasonably good balance among phase loads and currents in the polyphase case. Thus,

(1) For power without current transformers we have $\sqrt{3}\,EI\cos\theta = 2EI\cos 30\cos\theta$
(2) With current transformers we have $EI\cos(\theta + 30 - B) + EI\cos(\theta - 30 - B)$ Since $\cos -a = \cos a$, line 2 may be written $EI\cos[30 + (\theta - B)] + EI\cos[30 - (\theta - B)]$
(3) Then the ratio of power without current transformers to power with current transformers is

$$\frac{EI\cos(30+\theta) + EI\cos(30-\theta)}{EI\cos[30+(\theta-B)] + EI\cos[30-(\theta-B)]}$$

$$\frac{\cos 30\cos\theta - \sin 30\sin\theta + \cos 30\cos\theta + \sin 30\sin\theta}{\cos 30\cos(\theta-B) - \sin 30\sin(\theta-B) + \cos 30\cos(\theta-B) + \sin 30\sin(\theta-B)}$$

$$= \frac{2\cos 30\cos\theta}{2\cos 30\cos(\theta-B)} \quad \text{or} \quad \frac{\cos\theta}{\cos(\theta-B)}$$

which is the same result as given for single-phase correction.

(This proof differs slightly from that offered by E. C. Wentz in the ELECTRICAL WORLD of July 7, 1945 (pages 140, 142) but the end result is the same. Incidentally the parallel applies to watthour meters as well as to wattmeters—Editors.)

CORDS—
that pay their own way

NOW YOU CAN HAVE THEM . . . lightweight, flexible cords that are practically non-aging. They're protected with VINYLITE plastic insulation and establish new highs in safety, service life, and long-run economy. Drag and yank these cords over concrete floors—around machines and equipment. Their modern insulation stands the gaff, for it's remarkably tough and abrasion-resistant. Smear them with water, oils, grease, or most common solvents—expose them to alkalies and sunlight—the insulation retains its high dielectric strength. Further, VINYLITE plastics are inherently slow-burning, and non-flammable types are available when desired.

Unsurpassed on cords for portable tools and household appliances, VINYLITE plastic insulation is bringing new ease of installation, new reliability and safety to wires and cables in the public utility, communications, industrial, and construction fields, and for marine, radio, and aircraft applications. Its thin-wall construction permits more wires in existing conduits. It can be made in many colors.

Write Department 28-c for Booklet W-4, "VINYLITE Plastics for Wire and Cable Insulation." And call on Bakelite engineers at any time for help in applying VINYLITE plastic insulation, technically and economically, to your own requirements.

VINYLITE
TRADE-MARK
PLASTICS

BAKELITE CORPORATION, *Unit of Union Carbide and Carbon Corporation* UCC 30 EAST 42ND STREET, NEW YORK 17, NEW YORK

LOAD BUILDING

Induction Brazing Multiplies Tungsten Carbide Tool Production

ADAPTING INDUCTION HEATING for the brazing of tungsten carbide tips to more than 200 types of cutting tools effected such savings that the Willey's Carbide Tool Co., Detroit, Mich., was able to amortize the cost of two induction machines in three months time. Experience was that "shipments went up 20 percent in one month with no increase in manpower and where certain jobs had costs as high as $4.00 per hour, the use of induction brazing had reduced these same costs to as low as 30 cents an hour."

These operations are being performed on two 15-kw., two-station, 9,600-cycle units of standard Ohio Crankshaft—TOCCO Process make, equipped with water-cooled inductor coils easily changed to accommodate different tools. With two stations each, these units are located in the production area of the shop where they provide full-capacity operations.

Compared to other methods used to braze tips, the following cost-cutting advantages of induction treatment are cited: (1) Induction eliminates removal of excess metal from the shank of the tool. (2) It does away with wiring tip to shank. (3) It reduces wear on the finish grinding wheels by elimination of the wiring on tip. (4) It is cooler and cleaner. (5) It is a more positive, uniform type of braze. (6) It holds rejects to a fraction of a percent.

Tools are held beneath the inductor by one of three methods, one of which is a rotary chuck. The other two are a screwclamp fixture and a magnetic chuck block of which two sizes are used. With the magnetic block big tools can be easily positioned beneath the inductor in rapid fashion where they are held firmly during the brazing cycle.

The rotary fixture, designed in the shops of the Willey's company, is a transite block 6 in. in diameter mounted on a revolving spindle attached to an upright support. The block has a capacity upwards of 20 tools ranging in size from $\frac{1}{4}$ to $\frac{3}{4}$ in. square and of moderate length.

Held by Spring Tension

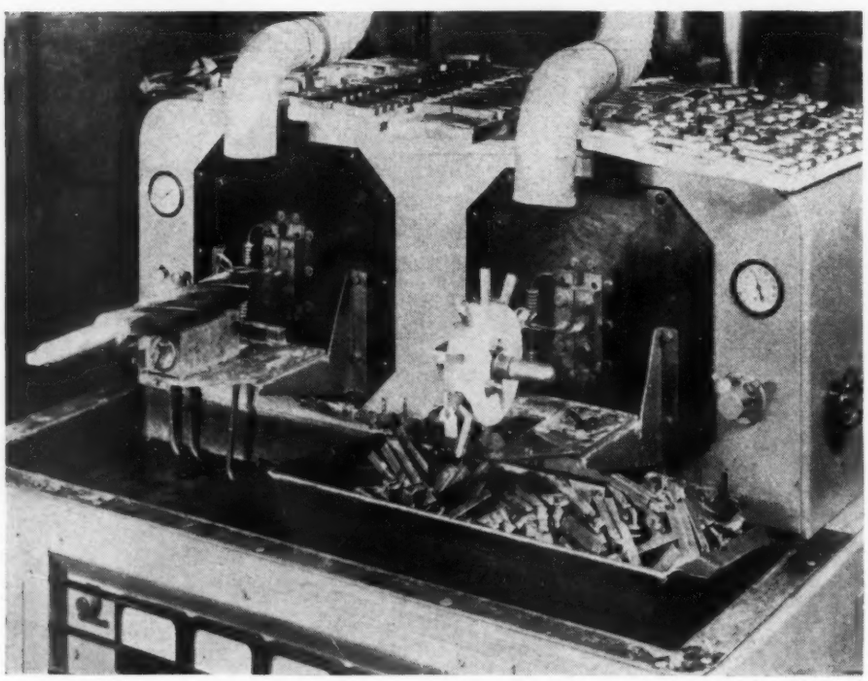
The tools are held in the fixture by spring tension and as the operator rotates the block the tool enters the field of the inductor coil where it becomes heated. The tip is "wiped" in place by the operator during the heating after which the tool passes down and out of the inductor as the very short cycle concludes. Held by mechanical tension until it arrives at the vertical, the tool is released automatically from the fixture and drops into a tote box or onto a conveyor below.

Because the flux is sufficiently adhesive, it is not necessary to hold the tip in position by any other means as the tools pass into and out of the inductor.

Further advantages of the induction method are reported to be the opportunity to silver solder high speed steel tips without drawing the hardness of the tip. Also, induction heat simplifies the removal of a brazed tip from a shank by quickly remelting the brazing material.

Larger tools are now being treated in greatly increased quantities. Two girl operators turn out 85 of these an hour on a two-station unit in contrast to the 80 tools per 8-hr. day by older methods. It is with these larger tools that induction's economies are seen to best advantage and the method of operation is the utmost in simplicity. The magnetic chuck block is used to hold the big shanks.

Achieved by the induction process for the first time is the brazing of a two-tipped tool without the wiring re-



HAND OPERATED rotary fixture (right) speeds up induction brazing of carbide tool tips. Magnetic chuck (left) handles larger tools

Frigidaire's new schooling idea strengthens partnership of Dealer . . . District . . . Factory

• A new program of schooling, greater in detail and wider in scope than ever before in Frigidaire's history, was recently begun at the Frigidaire factory.

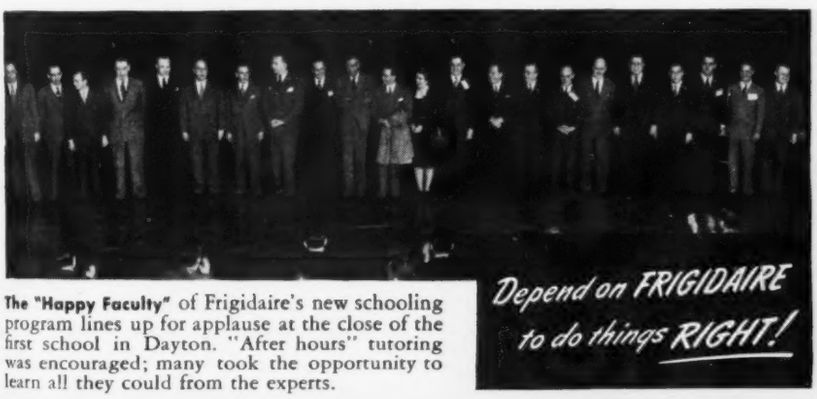
This new and totally different training program recognizes the changes of the last four years . . . the many variations of old problems which will soon prevail in the retail appliance business; and is planned to reach all District personnel, including dealers and salesmen.

The program calls for a continuing series of schools at the factory. All District Representatives and other executives of Districts and Factory, foreign and domestic, are enrolled. Many have already completed the required two weeks of intensive training, are already applying all they learned.

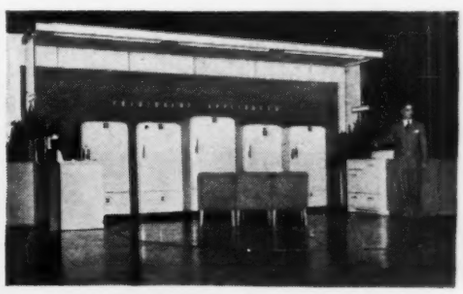
By complete analysis and discussion of each individual Dealer problem, the District Representative receives up-to-the-minute information on dozens of subjects, such as: "Hiring, Training, and Compensating Salesmen," "What To Look For When Signing a Lease," "Making Money In The Replacement Business," etc., etc. Thus, he gains the knowledge necessary to help the Dealer with his many problems . . . the kind of knowledge that will broaden and tighten the feeling of partnership that has always existed among the Frigidaire Dealer, District, and Factory.

Here, then, is another example of Frigidaire's Leadership. Another proof of Frigidaire's awareness of the needs of its Dealers. Another reason why Frigidaire Dealers know they can . . . Depend on Frigidaire To Do Things—Right!

Ellsworth Gilbert, Sales Promotion Mgr., receives congratulations for his staff from P. M. Bratten, General Sales Manager, for directing the school, which requires nearly two weeks, many evening sessions included.

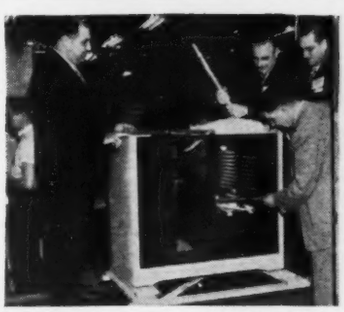


The "Happy Faculty" of Frigidaire's new schooling program lines up for applause at the close of the first school in Dayton. "After hours" tutoring was encouraged; many took the opportunity to learn all they could from the experts.



The Frigidaire "Selling Station", a new dealer selling help produced by Frigidaire, is explained by Insco Williams, Asst. Adv. Mgr. Another feature in Frigidaire's plan to meet today's new and different selling problems.

Actual Production Operations are part of the curriculum of the new school. All students see and learn about the construction of Frigidaire products; later taking tests on their knowledge of these construction features.



Learning First Hand how the Frigidaire Electric Range is built, P. L. Preston, W. H. Waade, T. H. Dempsey, and C. O. Nessler as they helped insulate an oven liner.

Actually Cooking a Meal on a Frigidaire Electric Range is part of the new schooling idea. "Learning by doing," Frigidaire District Representatives know how the product operates in the home, become acquainted with all its convenience features.

You're twice as sure with two great names

Frigidaire** made only by **General Motors

quired to secure the tips for treatment by other methods. The tips are held in place during the heating without extra support.

Brazing diamond dressing tools, for straight or radius dressing, having but a single diamond, was always difficult to handle and slow. Now, after the stone is positioned and the matrix base is pressed into the tool cavity around the diamond, one girl can braze 150 to 200 half-inch tools an hour. The cycle is 3 sec. heating per dresser.

Two interesting and formerly difficult jobs are the brazing of tips to line reamers having a 20-deg. spiral with inserts running the complete length of the 5-in. cutting edge, and the brazing broach buttons ¼ to 1 in. in diameter. Each of these operations is now quickly and uniformly accomplished by induction heating.

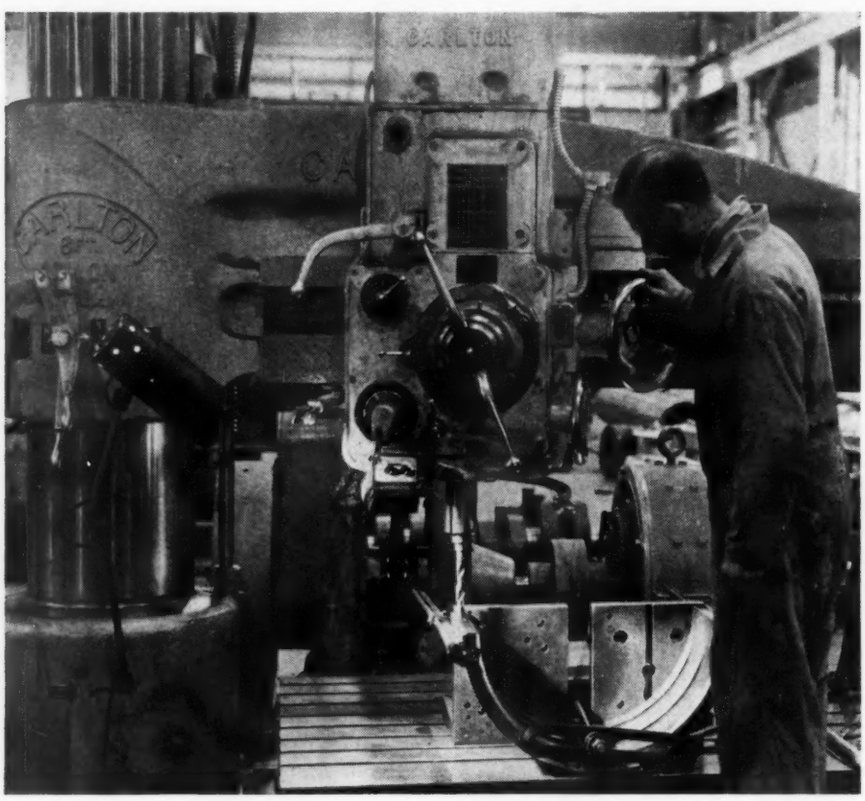
• • •

Up to 1,000 Foot-Candles Intensity Is Used for Critical Seeing Tasks

CRITICAL seeing tasks requiring from 250 to 1,000 foot-candles are being met in a number of San Francisco machine shops and industrial plants by use of the flexible local lighting unit illustrated.

The portable unit, designed by W. C. Macy, lighting specialist, Burlingame, Calif., is made in two types. One takes either a 150-watt or 300-watt spot or floodlight and the other uses the pear-shaped, 150-watt silvered bowl lamp. Upwards of 1,000 foot-candles is obtained with the former and approximately 250 foot-candles with the latter.

One or more of the lamps with swing-away mounting are conveniently located so that they may be focused on points requiring high intensity. Mounting arrangement, often on a boom, permits all essential movement, including swinging clear of a material handling crane where used.



LOCALIZED LIGHTING UNIT provides approximately 300 foot-candles on drill. General illumination is 25 foot-candles. Two such flexible swing-away units can provide up to 1,000 foot-candles

Three "Musts" of Store Lighting*

R. J. CHAPIN
Marshall Field & Co., Chicago, Ill.

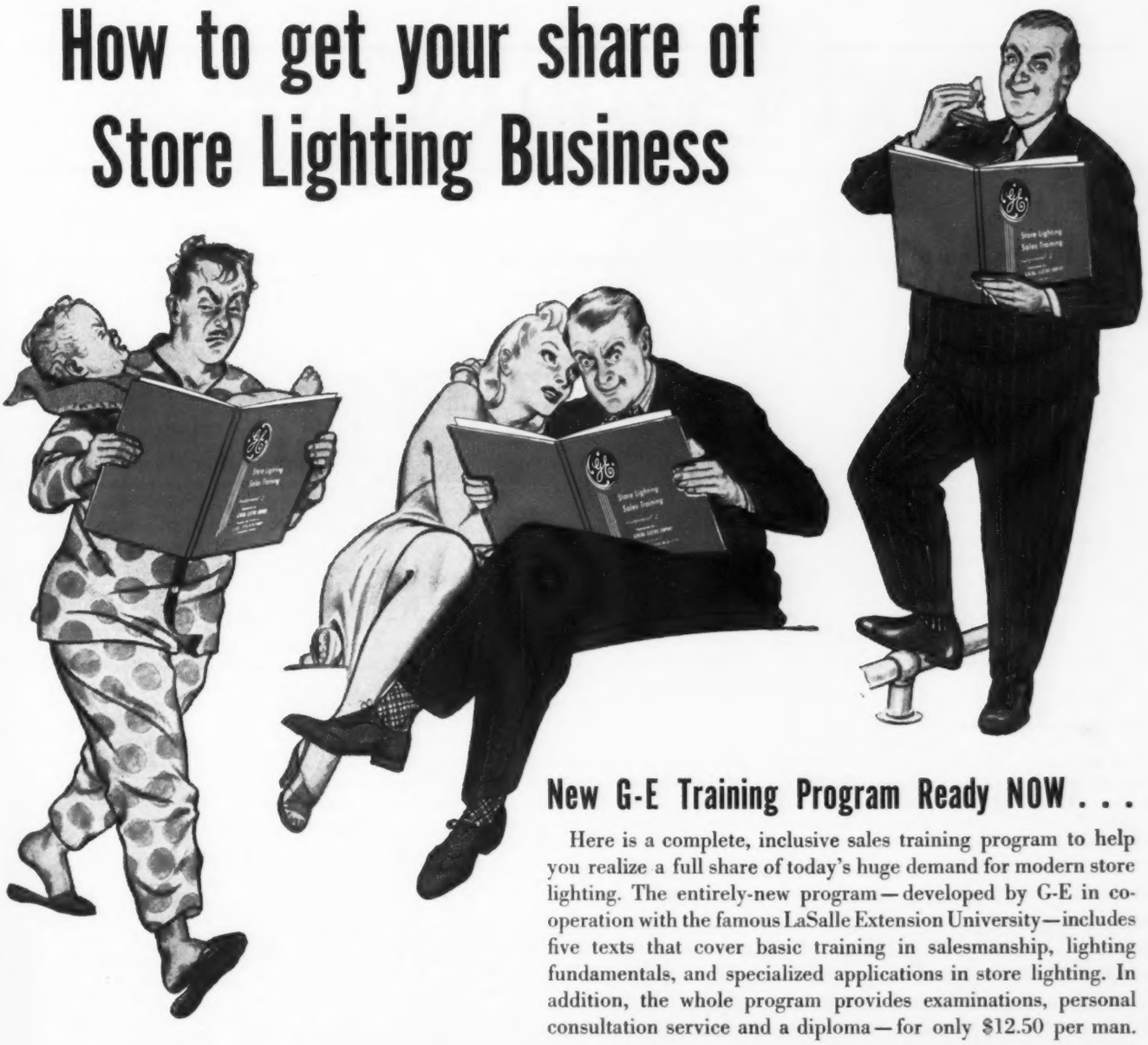
ONCE THE CUSTOMER is inside the store we have the problem of solving three "musts" of good store lighting. We *must* attract the customer to the merchandise by making it easy for her to locate, it *must* appeal to her eye, she *must* really be able to see it, thereby making it easy to purchase. Remembering that it takes about 3½ times longer for the eye to perceive small detail under 2 foot-candles than it does under 100, we need relatively high intensities of light to accomplish all these requirements. Yet the lighting atmosphere must be pleasant and not so intense or poorly fixtured as to distract her attention from the merchandise she is expected to see.

Proper handling of this problem will find the solution to providing the correct amount of light at the spot where it is needed. The 1-3-5-10 ratio of lighting is perhaps as good a way as any to express these amounts. This 1-3-5-10 basis is another way of defining certain areas in relation to each other in terms of foot-candles. Circulation areas are No. 1, counter tops are No. 3, show cases and back fixtures are No. 5, and promotional displays are No. 10. Therefore, whatever the light intensity in No. 1, the rest should be in direct relation as 3-5 or 10 times as great. This ratio helps put the correct amount of light where it counts the most, so as not to overemphasize floor, ceiling or walls—which we are not selling—but on displays and groups of merchandise. This difference in lighting intensity provides the feeling of balance to the entire scene. Any picture or scene must have its high and low areas of light to avoid an over-all flatness. We must have "centers of interest" in order to focus the eye on particular spots; otherwise all is incoherent or confusing to the customer.

With the 30- to 60-foot-candles levels on the counter, now entirely practicable, lighting fixture design and planning are of utmost importance in order to achieve the publicized three attributes of good store lighting—namely, attraction, appraisal and atmosphere.

* From paper at Edison Electric Institute sales meeting.

How to get your share of Store Lighting Business



New G-E Training Program Ready NOW . . .

Here is a complete, inclusive sales training program to help you realize a full share of today's huge demand for modern store lighting. The entirely-new program—developed by G-E in co-operation with the famous LaSalle Extension University—includes five texts that cover basic training in salesmanship, lighting fundamentals, and specialized applications in store lighting. In addition, the whole program provides examinations, personal consultation service and a diploma—for only $12.50 per man.

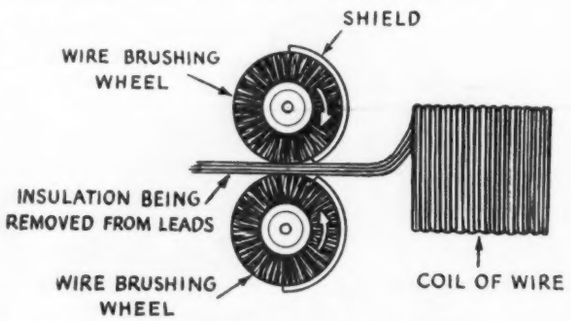
Training in store lighting salesmanship is only one of General Electric's brand-new, easy-to-use, and all-inclusive sales training programs. All are ready NOW.

For full information on the G-E LaSalle Sales Training Programs—Basic, Store, Office, Industry, Home—see your G-E Lamp representative. See him without delay—TODAY!

NEW EQUIPMENT

Power Brushing Steps Up Wire Stripping Operation

POWER BRUSHING has proved to be an effective method for stripping insulation materials of certain kinds from the contact ends of electrical wires, officials of the Osborn Mfg. Co., Cleveland, Ohio, stated in pointing out a new unit.



Brushing is reported to solve the difficult problem of stripping and cleaning synthetic insulation materials such as "Formex" and Formvar" and various combinations of cotton, silk, asbestos, enamel and similar products from round, flat, solid or stranded wire. It is reported as especially adaptable to the cleaning of fine "Litz" wire since brushing removes the insulation embedded in the stranded wires.

The stripping of insulation by brushes is accomplished by arranging two rotary brushes so that their axes of rotation are parallel and their brush faces in contact, as illustrated by the sketch. By inserting the ends of the wire to be stripped, the direction of rotation pulls the wire in, as a wringer would operate. The wire may be held in the hands of the operator, or by some other device, and the length of the wire to be stripped can be regulated by adjustable stops.

Wire-stripping brushes are available in sizes ranging from $\frac{3}{4}$-in. to $1\frac{1}{2}$-in. outside diameter. Small sizes are generally needed to allow the wires to be brushed within a short distance of the coil. As a general rule, wire stripping brushes are filled with wire ranging in size from 0.002 in. to 0.006 in. although some operations require wire as coarse as 0.014 in.

•

Lock Feature Reported On Pressure Switch

Pressure ranges up to 150 psi. are now available in sealed-in snap action switches made by the Nason Co., 7663 Epworth Blvd., Detroit 4, Mich. Pressure adjustment can be locked and sealed against tampering. The switch is rated at 6 amp. at 64 volts d.c. or 10 amp. at 110 volts a.c.

Direct wire connections are made through a grommeted opening in the steel cover to the insulated terminals. The diaphragm is made of Fairprene which is backed by a mushroom shaped plate to prevent stressing of the diaphragm.

One-eighth-in. inlet is reported to prevent clogging and the mounting bracket is stated to be adjustable to meet individual requirements of cable connections. The snap action switch can be changed from normally open to normally closed by transposing one wire. The unit is reported as approved.

•

Electric Furnace Made With Optional Features

TWO NEW optional features have been added to the company's line of electric furnaces, Cooley Electric Mfg. Co., Indianapolis, Ind., reports. The standard furnace is made with a hinged door, which, when opened, forms a loading shelf or, as an alternate design, with a counter-weighted vertically operated door for use where only partial door opening of the furnace is required.

The furnace is made in two sizes; MH-3 has a chamber size of 8 in. x 6 in. x 14 in. and MH-4, 10 in. x 6 in. x 18 in. They are built for continuous operation at 1,750 deg. F. or for intermittent operation at 1,850 deg. F. The heating elements are removable and replaceable and are reported to bring the chamber up to 1,400 deg. F. in 40 min. and to 1,850 deg. F. in 55 to 65 min.

•

Electronics Enters Toy Field Via Trains

ELECTRONICALLY CONTROLLED TRAIN is a recent engineering accomplishment made in the toy industry by Lionel Corp., 15 East 26th St., New York City. Radio waves of a definite frequency are transmitted to the miniature receivers (about the size of a man's wrist watch) incorporated in the car. To move one or more trains forward, or in reverse independent of each other, to whistle, to uncouple, or to operate any of the mechanisms of the animated cars (dumping or unloading), all are made possible since each receiver responds to only one of ten fixed frequencies.

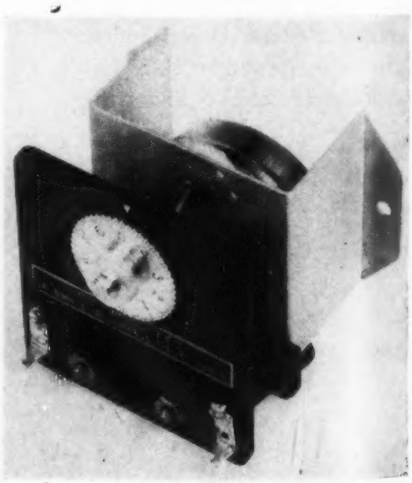
•

Reset Timer Range 1 Sec. to 10 Min.

AN ADJUSTABLE reset timer that is stated to meet most time delay reset timer requirements is being announced by Haydon Mfg. Co., Forestville, Conn. It is made with either 1/10-, 1-, or 4-rpm. motors, giving a range of delay from 1 sec. to 10 min. The over-all size, including graduation dial and adjusting knob, is $3\frac{3}{8}$ x $2\frac{7}{8}$ x $2\frac{7}{8}$ in.

The motor is reported to feature a magnetically controlled clutch that automatically engages the gear train when energized and disengages when deenergized. When the current is turned off, the drive shaft returns to its starting position by spring action.

Motor is furnished with one-way friction



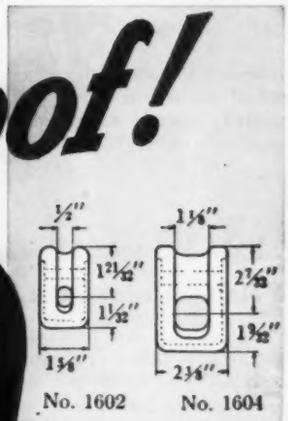
30 years of Proof!

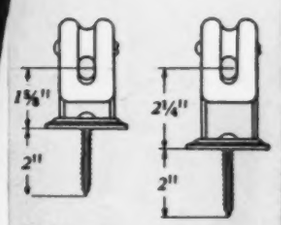
HUBBARD No. 190 WIREHOLDER

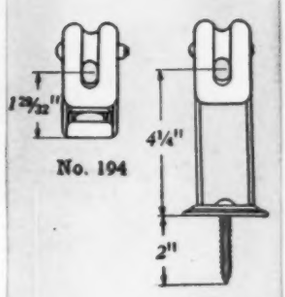
For more than 100 years, Hubbard and Company has enjoyed the privilege of serving industry with its greatly diversified products of the durable goods class.

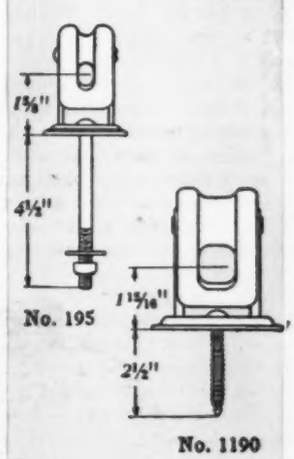
During the latter half of this century of service, the most notable group of materials has been a complete line of Pole Line Hardware, and for more than thirty years, Hubbard No. 190 Wireholders have been produced in quantities reaching well into the millions.

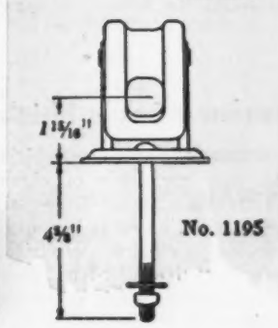
This old, reliable design with its variations shown here, is the favorite of many engineers and linemen from coast to coast. They know, that in thirty years of service, the Hubbard No. 190 has encountered every hazard to which a wireholder may be exposed. They know it has a slender pointed, full threaded screw for easy starting and maximum holding power in sheeting or solid wood. They know that its strength is much greater than that of the average service wire. They have discovered that this strength is due to the fact that the porcelain insulator is in compression with metal supports, not in tension, which is the weakest state of porcelain. They have thirty years proof that the Hubbard No. 190 has what they want in a wireholder.











Stock No.	DIMENSIONS—INCHES				Approximate Shipping Wt. Lbs., 100 Pcs.
	Insulator	Size of Screw, Bolt or Tap	Extension Base to Ctr. of Wire Hole	Size of Wire Hole	
190	1602	No. 22 x 2 Wood Screw	1-5/8	9/16 x 3/4	105
190-A	1602	No. 22 x 2 Wood Screw	2-1/4	9/16 x 3/4	115
190-R	1602	No. 22 x 2 Wood Screw	4-1/4	9/16 x 3/4	150
194	1602	5/8 Tap	1-29/32	9/16 x 3/4	95
195	1602	3/8 x 4-1/2 Carriage Bolt	1-5/8	9/16 x 3/4	140
1190	1604	No. 24 x 2-1/2 Wood Screw	1-15/16	1-1/8 x 1-1/8	228
1195	1604	3/8 x 4-5/8 Carriage Bolt	1-15/16	1-1/8 x 1-1/8	240

HUBBARD and COMPANY

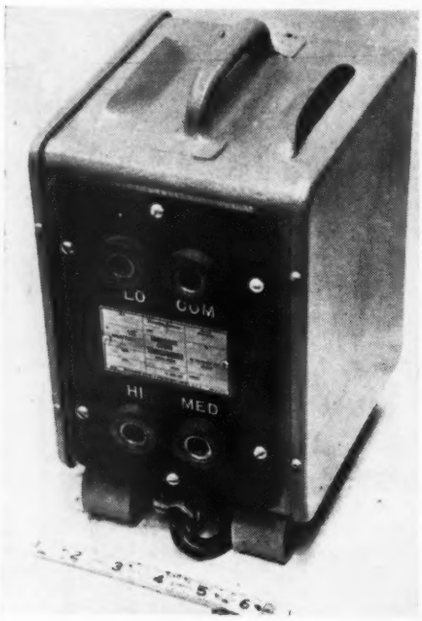
PITTSBURGH • CHICAGO • OAKLAND, CALIFORNIA

to absorb the shock to the gear train at the end of the return travel. The timer switch, normally opened or closed, is rated at 10 amp., 125 volts.

•

5-Kva. Portable Brazer Weighs About 30 Lb.

FOR MAKING lap joints in copper strap, attaching terminals to cable, brazing coil ends and general copper smithing work, a



new portable 5-kva. brazer weighing approximately 30 lb. is announced by the Westinghouse Electric Corp., Pittsburgh 30, Pa.

The new brazer, which requires connection to a 220-volt source, consists of a transformer, voltage selector, controls, and carbon-tipped tongs. Alternating current from an adjustable voltage transformer passes through the tongs and parts to be brazed, raising the temperature to a point at which the brazing alloy melts. The brazing alloy may be applied in rod or in ribbon form. Three outlets are provided on the control panel for 8, 6 or 4 volts. Voltages are adjusted by inserting bayonet plugs which are attached to the brazing leads into plainly marked receptacles. A foot switch with pilot cable serves as the primary control switch.

For use with air-cooled tongs, the new brazer is supplied with a handle for carrying. It is cooled by natural air circulation; air enters the bottom, is expelled at top.

•

Antenna Leads Shielded

A NEW LINE of motor vehicle radio antennas, that are made of chrome-plated admiralty brass, have silver-to-silver contacts, are mounted on ceramic stanchions, and are reported to eliminate electrical interference because of the radar-type shielded leads and connections, is being announced by General Electric Co., Syracuse, N. Y.

Commercial and Home Units Brought Out

THREE new fluorescent units—one for commercial or office use and two for home installation—are being announced by L. J. Segil Co., 2500 West North Ave., Chicago 47, Ill.

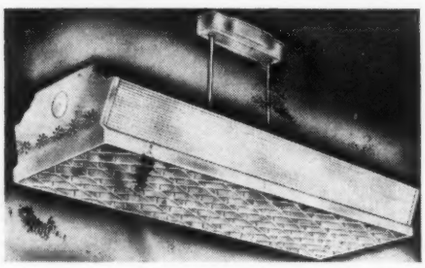
The FHLS 448, "The Light Director," is a 49-in. unit with sides of diffusing glass and a reversible bottom louver which is stated to minimize glare and light loss. The unit may be mounted directly on the ceiling (without stem hangers) by using ceiling mounting tracks.

Units may be easily gauged end-to-end, either ceiling or pendant mounted, through the use of connecting holes provided in the ends. They are made in two, three, four and five 40-watt types with regular starter switch and in two and four 40-watt types with instant start auxiliaries.

The "Decolite" is a decorative light designed for side lights on medicine cabinets, in halls and other similar places. It has a glass front which eliminates glare and is available in 14-, 15-, and 20-watt sizes. The unit is complete with an "On-Off" switch.

"La Boudoir" is a two-light 20-watt glass enclosed fixture for use in bedroom, dinette, sun parlor, etc. It mounts flush to the ceiling or can be used with a 4-in. adapter. It is 25 in. long and 10 in. wide.

The diffusing glass is decorated with green tinted leaves, pastel pink flowers on a soft cream colored background sprinkled with a leafy pattern.



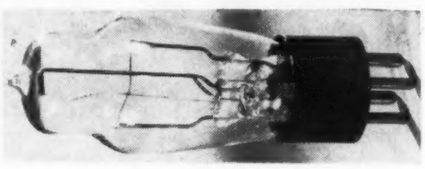
•

Thermocouple Tube Measures Low Pressures

A TUBE with a hot junction of a thermocouple element centered on a filament heater and designed to measure gas pressure changes through variations in thermal conductivity of the gas has been announced by Sylvania Electric Products Inc., Electronics Division, Boston 15, Mass. Used with a microammeter, it is said to record pressures of 10-1 to 10-5 millimeters with plus or minus 5 percent accuracy.

Applications include laboratory use as a pressure-gage and leak detector in evacuating apparatus. Operated in a 3-volt battery and resistance circuit, it may be sealed directly into evacuating apparatus by means of tabulation provided on top of the bulb. Direct measurement may be made with an 0-250 microammeter which can be calibrated for each gas measured. Accuracy is said to be assured by shielding the equipment from sources of radiant heat and air currents.

The tube, $4\frac{7}{16}$ in. long over pins and $1\frac{9}{16}$ in. maximum bulb diameter, is supplied



with small 4-pin base and may be operated in any position. Maximum value electrical ratings are: filament resistance, 3.0 ohms; thermocouple resistance, 5.0 ohms; filament current, 125 milliamperes; and thermocouple current, 250 microamperes.

•

New Paper Provides Prints Without Inked Tracings

BLUEPRINTS made directly from a pencil drawing without retracing in ink is a result of a new development in papers, reports Monsanto Chemical Co., St. Louis 4, Mo., and H. P. Andrews Paper Co., 14 West 3rd St., New York City. It is reported made possible by the application of a modified silica product to the base paper before coating with light sensitive materials.

•

Deep Shielding Provided On Three New Fixtures

AMONG the developments being announced by Benjamin Electric Mfg. Co., Des Plaines, Ill., are three new models of fluorescent lighting units for industrial plants and offices. They are reported to feature the new longitudinal baffle based on the studies of deep shielding and now covered by RLM standards No. 22 and 23.

Included in the designs is the company's new fluorescent lamp socket, called the Springlox Safety Lampholder. This features a spring construction which increases the ease of inserting the lamp and eliminates the need of adjusting the lamp contact prongs in the socket.

The contacts are automatically centered in the lamp socket. The spring construction is also said to increase the safety factor since there is no way that the lamp can be removed from the socket except through a pushing movement of the hand grasping

SEE FAIRBANKS-MORSE FIRST FOR MOTORS

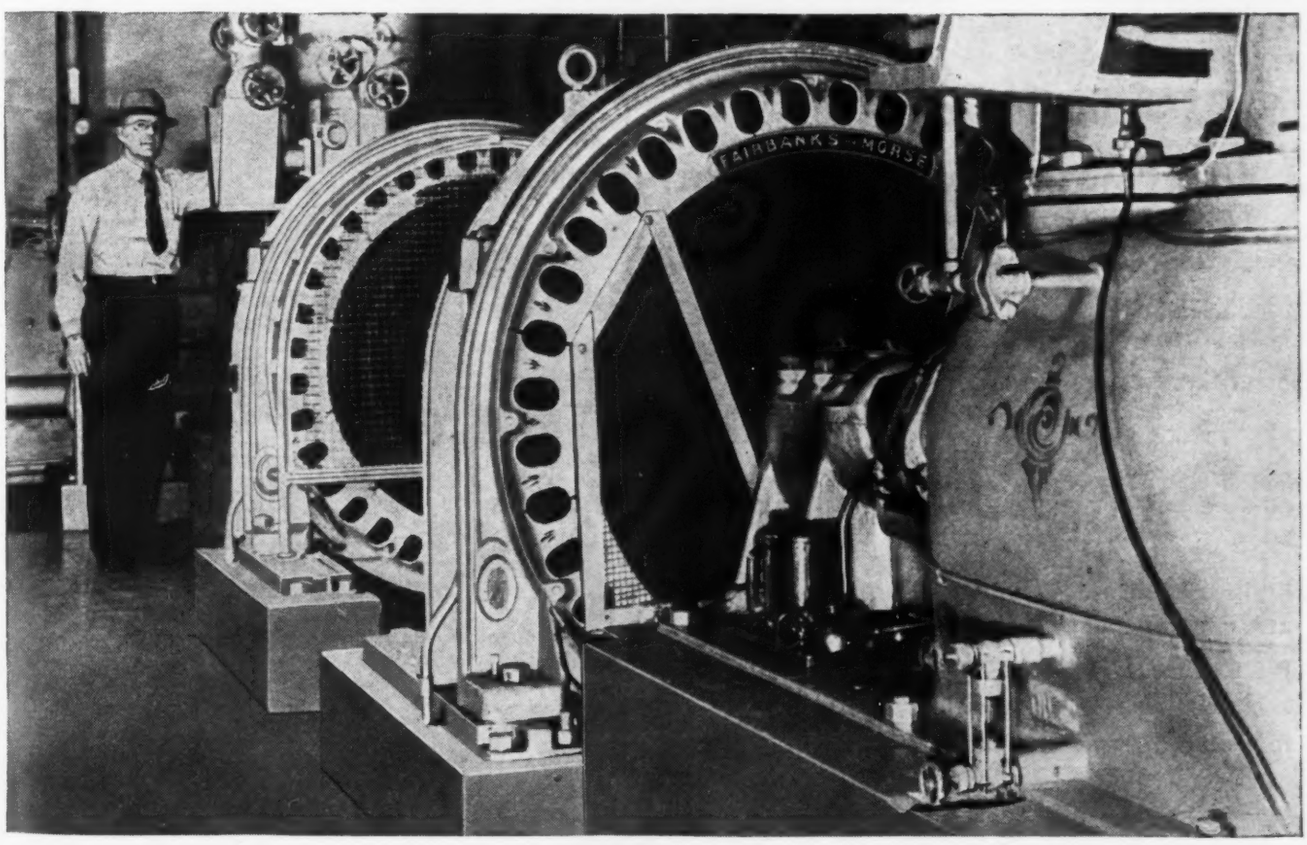
IMPROVED plant operation is something you can count on when you use Fairbanks-Morse *Synchronous* Motors.

These dependable units assure a better plant power factor, constant speed operation over entire load ranges, and truly economical service. Designed with modified torque characteristics, they can be adapted to a wide variety of applications.

Available in a full range of high and low-speed types, these motors are part of a full line of Fairbanks-Morse Motors and Generators now serving industry with performance-boosting economy. Write for details today.

Fairbanks. Morse & Co., Chicago 5, Illinois.

Fairbanks-Morse synchronous motors driving compressors



Fairbanks-Morse

A name worth remembering

Diesel Locomotives • Diesel Engines
Scales • Motors • Pumps • Generators
Magnetos • Stokers • Railroad Motor Cars and Standpipes • Farm Equipment

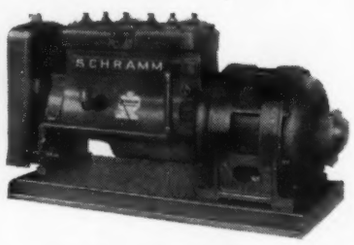
WHAT TYPE SCHRAMM AIR COMPRESSOR DO YOU NEED

Do You Need DIRECT DRIVE ON BASE?

Built-in Motor Drive mounted on steel base is compact and easy to install. No foundations necessary.

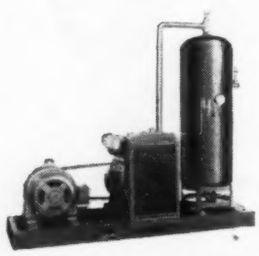
Do You Need DIRECT MOTOR DRIVE WITH COOLING UNIT?

Schramm 300 cu. ft. displacement with direct-connected 50 H.P. motor with cooling unit on Steel Deck Base.



Or— BELT DRIVE WITH TANK AND COOLING UNIT

mounted and ready for immediate installation? Belt Drive complete with motor, vertical air receiver and cooling unit all mounted on a single base.



SCHRAMM offers you a complete line of Air Compressors for your every need! Sizes range up to 600 cu. ft. displacement! Schramm's stationary units are widely used in plants throughout the country, and are specified because they are vibrationless, lightweight, compact . . . and at the same time easily furnish a steady flow of air. Write today for full details on Schramm Air Compressors.

SCHRAMM INC THE COMPRESSOR PEOPLE WEST CHESTER PENNSYLVANIA

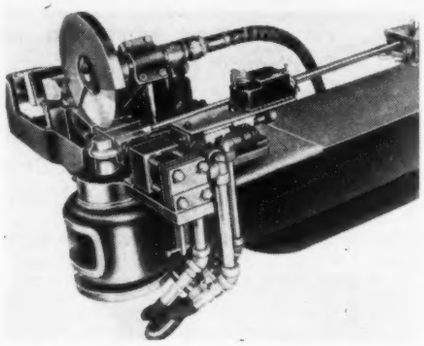
the lamp and pushing it further into the socket until the other end clears the socket.

One of the units, the Stream-Flo 40, is illustrated. This shows the lamp holder feature and the Lok-Latch feature. The Shield-Flo 40 is a closed end unit and the Twin-Flo 40 is an open end unit, each with similar features.

•

Cut-Off Attachment Is Completely Automatic

Pines Engineering Co., Aurora, Ill. announces an "Automatic-Cut-Off" for all six sizes of the company's automatic tube and



pipe benders which handle tubing from ¾-in. to 5-in. O. D. and pipe up to 4-in. O. D.

The No. ¾ Bender illustrated is equipped for full automatic manufacture of return bends or elbows. The machines uses the company's patented booster attachment for tube feed, and the automatic cut-off attachment. In operating the bender a long piece of tubing is placed over the mandrel and the "start" button pressed. After the machine finishes the bend, the mandrel is extracted and before the clamps are opened, the saw is passed through the tube by means of hydraulic power. The bending arm then returns and the mandrel advances. The tube is then fed automatically and the operation repeats. The machine continues to operate automatically until the tube is used up.

Typical production reported is 650 pieces bent and cut per hour from ¾-in. copper tubing, bent on a 1½-in. center.

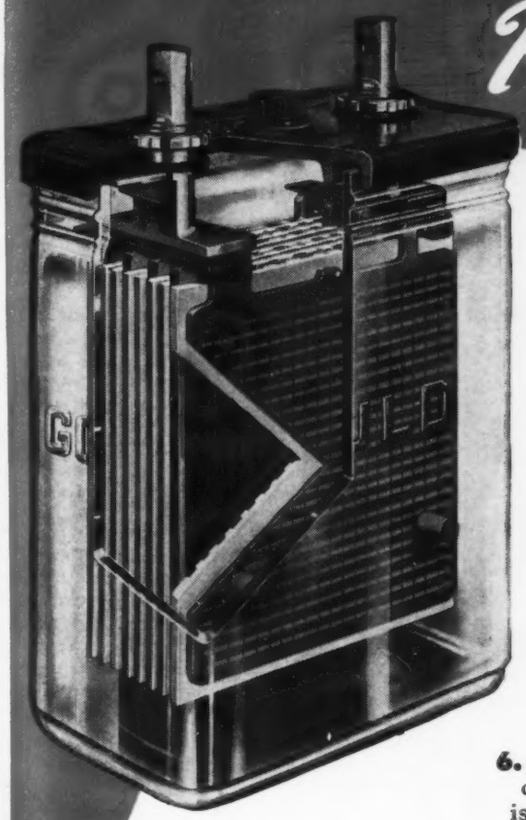
•

Light-Weight, 15-Amp. Control Relay Announced

Production of a new control relay which is stated to combine compactness and light weight with control operations has been announced by Allied Control Co., Inc., 2 East End Ave., New York, N. Y. Designated the "CR" type relay, it is claimed to be efficient on precision application in industrial and special control circuits.

Contacts are said to be large for this type of relay—up to ¼ in. in diameter—and are generally supplied in silver although alloy contacts are obtainable. Heavy gram pressure, inherent in the design, is reported to permit power switching heretofore possible only with larger relays. It is available

WHY DO ENGINEERS SAY *Planté* IS THE BEST?



1. One-piece, pure lead positives provide full plate performance throughout battery life.

2. One-piece, pure lead positives insure highest discharge rates for unfailing operation of electrical equipment.

3. Current output of one-piece, pure lead positives averages more than 23% above that of equivalent batteries.

4. One-piece, pure lead positives without holding structures provide longest possible life. They prevent partial deterioration that results in loss of capacity.

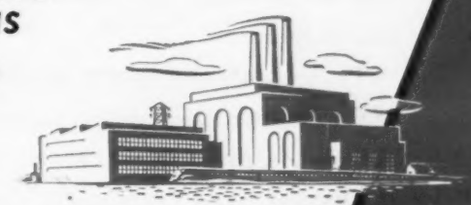
5. A dense film of active material covers entire plate area. This prevents peroxidization and disintegration, both of which result in lowered current output and shortened battery life.

6. One-piece, pure lead positives give greatest conductivity. This is due to an active material which is an integral part of the plate itself. Dependence upon mechanical electrical contact is avoided.

. . . BEST FOR UTILITY CONTROL AND STANDBY OPERATIONS

In many of America's largest electric generating plants the Gould Plante has proved itself the most dependable of all storage batteries. It delivers a high current output for speedy instrument operation and, because of its exceptionally long service life, over-all operating costs are low.

Gould also builds two other types of stationary batteries, Kathanode and Dreadnaught. Write Dept. 185 for Catalog 1000 on Gould Sealed-in-Glass Batteries for Stationary Applications.



GOULD *Planté*

PURE LEAD FOR LONGEST LIFE

GOULD STORAGE BATTERY CORPORATION, Depew, N. Y. Factories: Atlanta • Boston • Chicago • Dallas • Depew Emeryville • Los Angeles • Mount Vernon • Rock Island • Saint Paul • Salem • Sioux City • Zanesville

No matter what the enterprise or where it is located, the danger of its destruction by fire is always present.

That's a statement easily applied to so-called fire proof industrial buildings, warehouses, yes . . . even high voltage electrical equipment such as transformers, circuit breakers, voltage regulators and the like. Yet disastrous fires occur every day causing staggering losses to life and property.

There's only one answer to this picture of fire destruction and that is *fire protection that really protects* . . . no matter what the hazard. And "Automatic" Sprinkler is well qualified to handle your most difficult fire protection problem. What we can do for you is best told by one of our engineers. *Don't delay, write today.*

"Automatic" FIRE-FOG

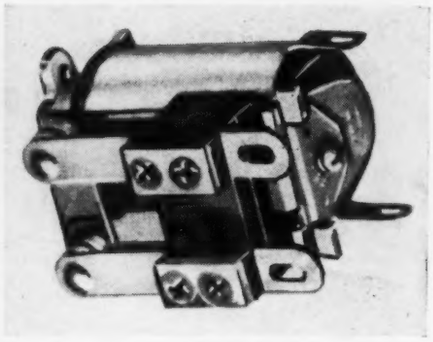
—a famous member of the "Automatic" Sprinkler Family. Provides adequate protection from fires originating in oil filled electrical equipment and other fires of flammable liquid origin.

"Automatic" Sprinkler

"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA

YOUNGSTOWN, OHIO . . . . . OFFICES IN 36 CITIES

"Automatic" Sprinkler designs, manufactures and installs a complete line of fire protection devices and systems for all types of fire hazards. Listed by Underwriters' Laboratories, Inc., and approved by Factory Mutual Laboratories



in two, three and four pole combinations, and if desired, hermetically sealed. Molded bakelite is used throughout for insulation and steel is used as a base.

Contact rating with $\frac{1}{4}$-in. silver contacts is 15 amp. at 24 volts d.c. or 110 volts a.c., non-inductive. The single pole unit weighs 3 oz., is $1\frac{33}{64}$ in. high, $1\frac{9}{32}$ in. wide and $1\frac{55}{64}$ in. long A variety of contact combinations is available in all models.

•

FM Antenna for New Bands

A NEW ANTENNA, called the 54A Antenna or "Cloverleaf," designed by Bell Telephone Laboratories, is being announced by Western Electric Co., 195 Broadway, New York 7, N. Y. It is designed primarily for use by frequency modulation broadcasting stations operating at the new FCC assigned carrier frequencies between 88 and 108 mc. and at power levels up to and including 50 kw.

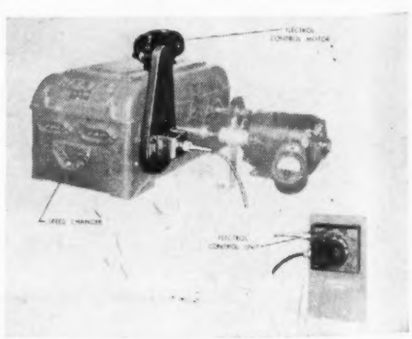
•

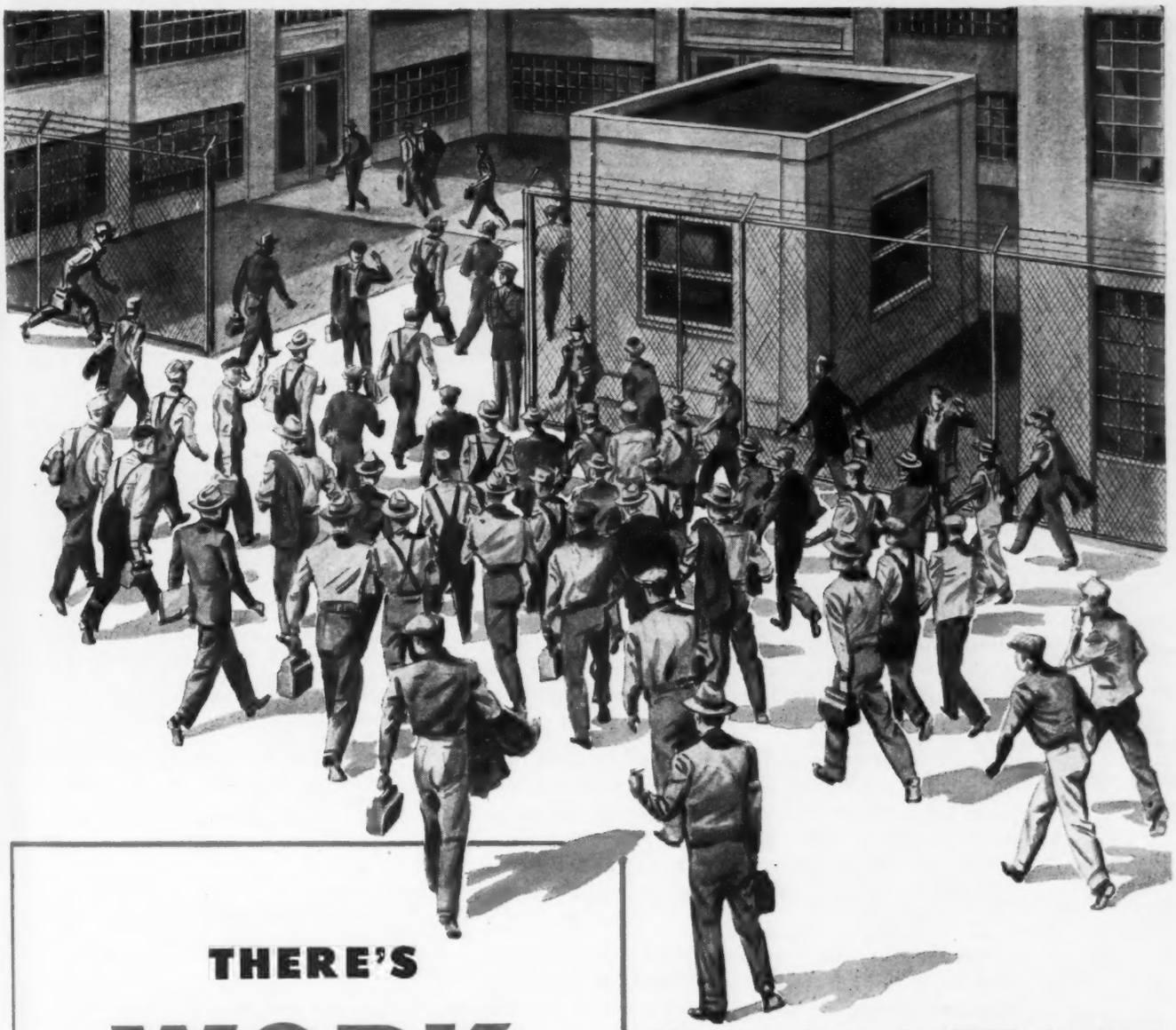
Remote Speed Control Provided Speed Changer

"Flectrol", a new product developed by Yardeny Laboratories, Inc., 105 Chambers St., New York 7, N. Y., when applied to commercial speed changers, is said to provide fingertip remote control of speed. The dial can be set to any desired speed and, the report continues, the speed changer will follow as fast as the servo electric motor can drive the speed adjusting screw.

The dial can be calibrated in rpm., ft. per min., gph., etc., depending upon the usage. Accuracies of better than 2 percent are reported between actual developed speeds and dial settings.

In operation, the unit controls the rotation of the small motor used to adjust the pulleys or gears of the speed changer. Rotation of the speed selector dial causes this





THERE'S WORK TO BE DONE!

There's no substitute for WORK when there's work to be done. Benefits of the great technological advances* of recent years can be unleashed only through production that puts them to work. Through mass production *everyone* gains . . . it's the American way to progress, to better living for all. Let's work, like Americans, for there's great work to be done.

**In paper, too, important technological advances have been made. MOSINEE "Paperologists" can help you make the most of modern essential papers in your product. Call for MOSINEE paper technicians!*

MOSINEE PAPER MILLS CO. MOSINEE, WISCONSIN

MOSINEE PAPER MILLS COMPANY

MOSINEE • WISCONSIN

Essential Paper Makers

Please address your letter "Attention Dept. B"

KLEINS *the finest in pliers*

Since the first wires were strung—bringing the marvels of electric light and power to America—the electrical industry has advanced far. Yet, it is significant that the electrician today still uses the same pliers his grandfather used back when the industry was in its infancy—Kleins.

Klein Pliers were originally made because this industry needed tools better than any then available. Klein Pliers are still standard in the electrical field, because through the years they have kept pace with electrical progress, because they are still recognized by men who know good tools as the finest pliers available.

Kleins today are made in a wide range of sizes and types to fit every electrical need. Because the demand is so great, your supplier may not be able to fill your order immediately, but keep on asking—remember Kleins are worth waiting for.

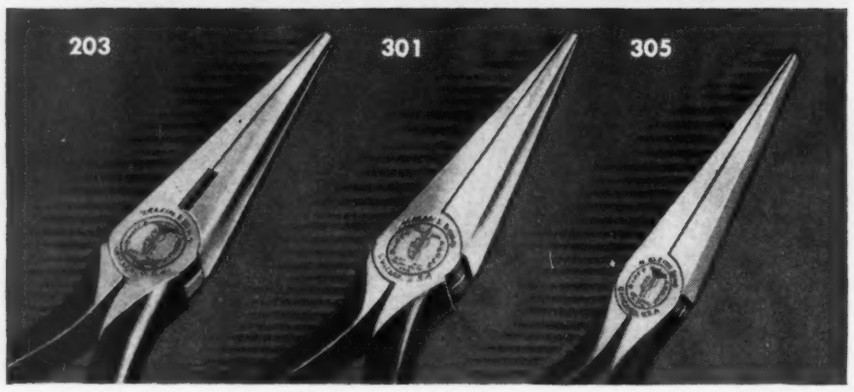
The Klein Pocket Tool Guide showing the Klein line and containing useful tables and information will be sent without charge.

ASK YOUR SUPPLIER

Foreign Distributor: International Standard Electric Corp., New York

Since 1857

Mathias KLEIN & Sons
Established 1857 — Chicago, Ill., U.S.A.
3200 BELMONT AVENUE, CHICAGO 18, ILLINOIS

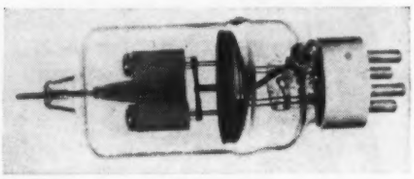


motor to drive the adjusting screw until the output speed of the control device corresponds to the speed on the dial. It is reported as applicable to new or existing equipment, as built-in or added auxiliary to motor operated valves, machine tools, conveyors, printing presses, etc.

•

Multi-Element Triode Utilizes New Plate Design

A new type 3-150A multi-element triode is announced by Eitel-McCullough, Inc., of San Bruno, Calif. The characteristics of this new vacuum tube are said to make it



suitable for many applications, including television and industrial heating. It incorporates a new design plate and a non-emitting grid, which are reported to insure maximum tube life plus high efficiency.

It is available in high mu (3-150A3) or low mu (3-150A2) versions, and is reported to include a number of engineering improvements.

•

Small Solenoid Valve Operates at High Pressure

Allied Control Valve Co., South Norwalk, Conn., has announced a new solenoid valve for applications in which a small electrically controlled valve is required to perform with a minimum of maintenance. It weighs 1 lb.

and requires a power consumption of 10 watts maximum and operates under pressures up to 150 psi.

It is a three-way two-position valve, and may be used with water, alcohol, hydraulic fluids, air and other media, for a.c. or d.c. operation and for intermittent or continuous duty.

The construction features stainless steel for all parts in contact with the fluid handles, coil impregnated to withstand moisture, and welded stems.

CATALOGS and BULLETINS

A monthly digest of recent manufacturers' literature compiled by Electrical World for your convenience in securing without obligation the most recent information on electrical and allied products

CHECK ON COUPON BULLETINS DESIRED AND MAIL TO US. WE WILL FORWARD REQUESTS TO MANUFACTURERS

1 DRY ELECTROLYTIC CAPACITORS: Catalog 10 illustrates and describes a variety of dry electrolytic capacitors, designed to meet specific requirements. Each type of capacitor is illustrated. Tubes and construction drawings are also given. Sprague Electric Co.

2 ADJUSTABLE-SPEED MAGNETIC DRIVES: Booklet 183, printed in three colors, contains factual data and over 40 illustrations covering E-M Magnetic adjustable-speed drives for boiler draft fans, centrifugal pumps, centrifugal blowers and compressors, and other loads where torque required decreases with reduction of speed. Principles of operation, performance characteristics, and applications are described and illustrated. Diagrammatic cross-section sketches are given showing constructional elements. Electric Machinery Mfg. Co.

3 METAL AND PLASTIC PRODUCTS: Bulletin contains a variety of products made of metal and plastics. Includes flat flange eyelets of different sizes; also special eyelets, ferrules, and terminals. Each item is illustrated. Tables giving sizes and material of which they are made are also included. Waterbury Companies, Inc.

4 TUNGSTEN ELECTRODES: Bulletin 154 describes and illustrates electrodes used for atomic hydrogen welding. Properties of high priority tungsten are given. A section is also devoted to helium arc welding. Callite Tungsten Corp.

5 CERAMICS: Bulletin 444 covers a variety of products made from ceramics for electrical and other uses. Electrical products, include mounting strips, bushings, spacers, pressed radio parts, electronic tube parts, tube bases, crystal holders, high frequency insulators, electric appliance parts, electrical controls, etc. Mechanical and electrical properties of items are also included. American Lava Corp.

6 ADJUSTABLE LIGHTING FIXTURES: Bulletin 44 describes and illustrates supplementary lighting fixtures, designed for a variety of applications. Fixture can be adjusted from any angle. Is better known as "below eye-level lighting" fixture. The O. C. White Co.

7 CONSTRUCTION FRAMES AND FITTINGS: Bulletin 1 outlines wide variety of uses for construction frames and fittings, already cut for quick building of special frames as well as providing support for various objects. With this type of construction, one can build practically any type of frame for supporting or holding pipes, conduits, etc.; and for storing bars, etc. Also, this material is widely used in constructing cabinets, barriers, vise benches, concrete inserts, clamps, conduit hangers, ladders, cable and insulator racks, scaffolding, motor bases, buscell, switch supports, panel boxes, power duct systems and a multitude of other electrical uses. Illustrations of every use are given. Unistrut Corp.

8 BRAZING ALLOYS: Folder 33 discusses method perfected by this manufacturer of low temperature silver brazing alloys. Complete details are given in the use of materials to obtain best results in brazing. This method is applied to compressor housings where copper tubing is brazed to unit. This is also used by the electrical industry to join copper bars and braze taps on coil conductors in transformers. Illustrations, showing effectiveness of this method, are included. Handy & Harman.

9 HYDRAULIC TURBINES: Bulletin A-45 presents turbines designed for medium and low head water power developments. Each type and size of turbine is illustrated, with incidental engineering data furnished. A low head, open flume installation for smaller developments is shown in a cutaway sketch. The James Leffel & Co.

10 LAMPS: Catalog contains data covering complete line of mazda and fluorescent lamps, including size of lamps, description, type of base, symbols used in identifying lamp, rated initial lumens, lumens per watt at 70 percent of rate life, etc. Lamps for a variety of applications are also listed. Consolidated Electric Lamp Co.

11 FLASH WELDING: Folder illustrates use of flash welding as applied to a variety of metal parts, rings, bands and assemblies. Method is illustrated by actual

Circle numbers, sign and mail

May 11, 1946

ELECTRICAL WORLD
330 West 42nd St., New York 18, N. Y.

Please send me, without obligation, manufacturers' literature herein described and identified by numbers circled below:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
15	16	17	18	19	20	21	22	23	24	25	26	27	28
29	30	31	32	33	34	35	36	37	38	39	40	41	42
43	44	45	46										

Print your name and address and be sure to include your title

NAME ..... TITLE.....

COMPANY .....

ADDRESS .....

CITY ..... STATE .....

SAFETY FOR HURRYING FEET!
BLAW-KNOX
ELECTROFORGED
GRATING and STAIR TREADS
The combination of one-piece electroforged grating and rolled diamond checkered nose-plate provides stair treads which withstand terrific impact... This feature is especially important as it assures safe footing on catwalks and engine room grating.
BLAW-KNOX DIVISION of Blaw-Knox Company
2013 FARMERS BANK BUILDING
PITTSBURGH 22, PENNA.

photographs. The American Welding Mfg. Co.

12 FITTINGS & WIRING DEVICES FOR THE FARM: Pull-out folder illustrates a variety of wiring devices and fittings, especially designed for use on farm buildings and structures. Includes service entrance heads, entrance elbows, sill plates, service entrance cable heads, yard lights, ceiling wall lights, ground clamps, outdoor weatherproof switch housing, etc. Full-size illustration of each unit is shown. Killark Electric Mfg. Co.

13 ADJUSTABLE LIGHTING APPLIANCES: A 30-page booklet features a multitude of adjustable lighting appliances for a variety of uses. Information is supplied on type of bed fixtures, bench fixtures for industrial applications, including ceiling fixtures, clamp-on fixtures, counter portables, cylindrical shades, daylight units, desk fixtures, etc. Complete data accompany each type of fixture. The O. C. White Co.

14 HIGH FREQUENCY HEATING EQUIPMENT & ACCESSORIES: Multicolored booklet illustrates various uses of industrial high frequency dielectric heating equipment. Opening section discusses importance of electronic tubes in the use of this equipment. Another section deals with the more important applications in the textile industry. Also mentions value in the manufacturing of resins, plastics, plywood, foods, ceramics, rayons, paper, rubber and chemicals. Illustrations show types of units available. Accessory equipment also shown. The Girdler Corp.

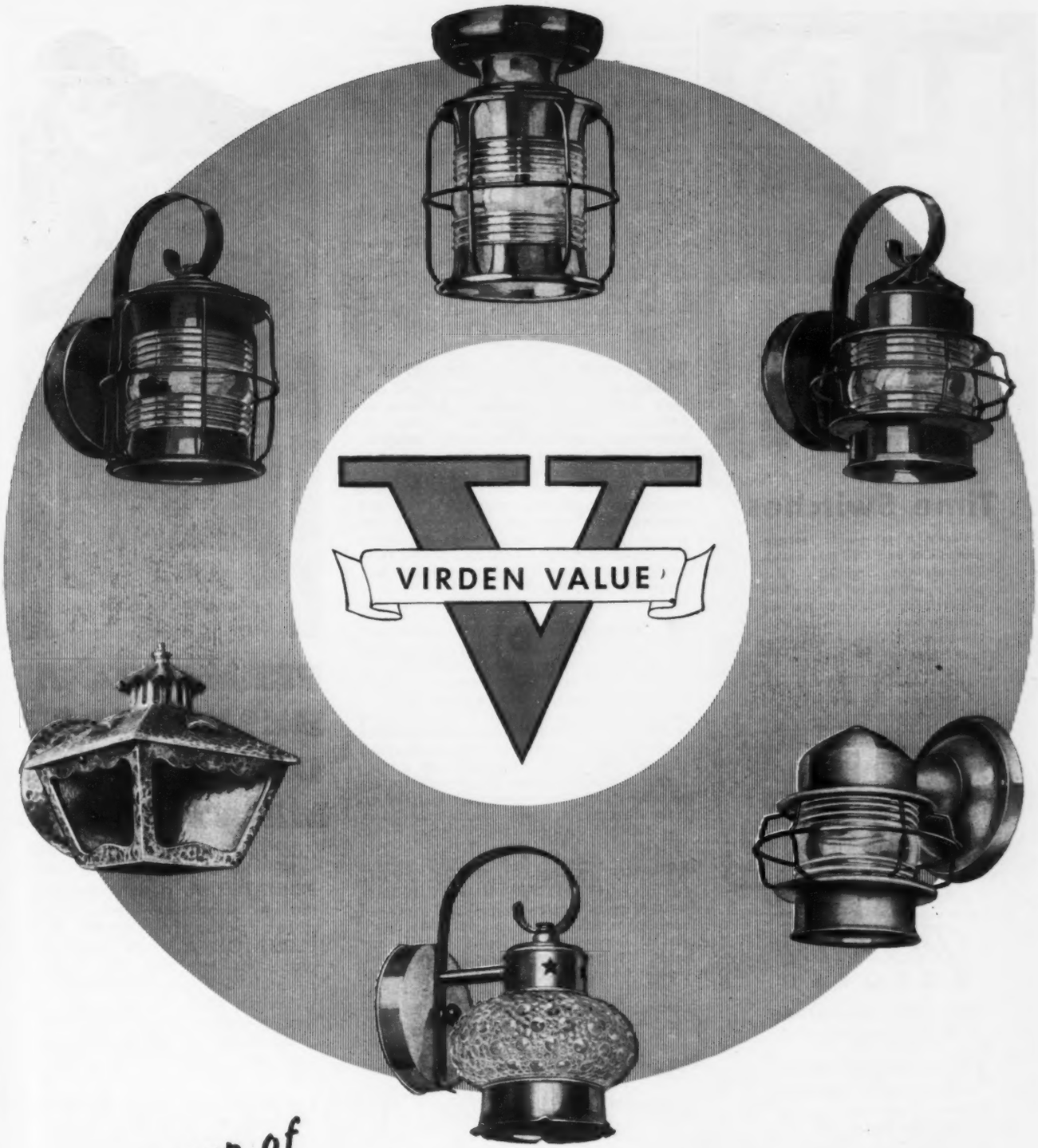
15 RESIN: An 8-page booklet discusses the chemical and physical properties as well as the application of "Poly-Pole" Resin. Two important uses of resin are as a sealing compound for dry-all batteries and as an ingredient for impregnating compounds and insulating varnishes which normally contain resin. Hercules Powder Co.

16 MOBILE RADIO TELEPHONE: Folder features new mobile radiotelephone. A brief description of the set is given. Method of operation is also noted, together with outstanding features each given in detail. Western Electric Co.

17 INDOOR DISCONNECTING SWITCHES: Bulletin 139 contains 38 pages of detailed technical data covering a wide variety of indoor disconnecting switches. Specifications are included and cover current carrying parts, locking devices, terminals, blade stops, insulator units and bases. Tables giving current ratings are also included. Each unit is drawn to scale, showing minute engineering details. Electrical Engineers Equipment Co.

18 FASTENERS: Catalog describes and illustrates quick-lock and spring-lock fasteners. Also discusses a variety of dual purpose safety nuts. Design and construction of items are given. Also, engineering data as well as installation instructions are included. Simmons Fastener Corp.

19 FITTINGS: A pull-out folder titled "Rural Electrification" lists a variety of electrical fittings designed for exclusive use in electrifying the farm. Equipment is designed principally for outdoor applications. Includes entrance caps, elbows, cable heads, service entrance fittings, sill plates, ground

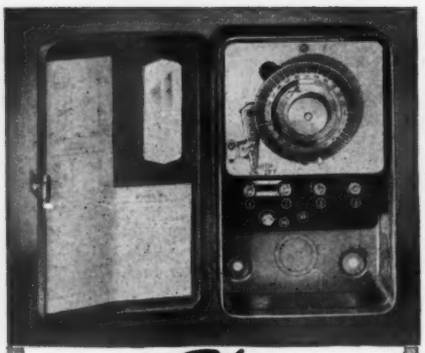


A group of Smart Outdoor Lanterns

• Designed and styled for today's markets—apartments and houses—the Virden line of Outdoor Lanterns hits current needs right on the button. Demand is strong, shipments satisfactory. To make sure of requirements, see your Virden wholesaler promptly.

John C. Virden Company • Cleveland, Ohio

Member American Home Lighting Institute



The

"TOP" VALUE

in Time Switches

Here's a top-quality, service-proved ON and OFF time switch. Precision built . . rugged and durable . . . with a great performance record. Highly successful for controlling motors, valves, pumps, blowers, oil burners, stokers, attic fans, commercial lights, etc.

A leader when first introduced over ten years ago, now includes many improvements, one of them being telechron motored. Increased volume and war-learned manufacturing efficiency have brought price down to $10.75 list. Write for complete bulletin:

Paragon 300 SERIES Now $10.75 List

Telechron MOTORED

OPERATING ADVANTAGES

1. Self-starting synchronous operation.
2. Complete self-oiling lubrication, patented capillary oiling system.
3. Years of continuous and uninterrupted operation.
4. Practically instantaneous self-starting at full rated load.
5. Gear reduction fully sealed to exclude dust and dirt.
6. Lower power consumption.
7. Underwriters' approved.

PARAGON ELECTRIC COMPANY
703 OLD COLONY BUILDING
CHICAGO 5, ILLINOIS

Paragon Chicago
BUILDERS OF ELECTRICAL EQUIPMENT SINCE 1905

clamps, and light receptacles, each equipped with a heavy porcelain enameled reflector, designed for mounting outdoors. Also features a variety of weatherproof receptacle fittings, flush toggle switching for indoor use, duplex receptacle fittings, etc. Graphic illustrations, showing farm buildings wired to equipment discussed, are given. Killark Electric Mfg. Co.

20 SAFETY LAMP CHANGER: A 4-page folder describes a new device for changing electric light lamps, broken or burned out. This item enables the maintenance man or anyone else replacing burned out lamps to remove them from their sockets safely and quickly without the use of step ladders. G. R. Chadsey Mfg. Co.

21 CONTROLS AND RESISTORS: Catalog 46 lists a variety of resistors, controls and resistance devices. Includes information about wire-wound power resistors and glass-insulated flexible resistors; composition-element and wire-wound rheostats and potentiometers; tapped and tapered controls and switches; constant impedance input and output controls and attenuators; tube-type wire-wound resistors, automatic line voltage regulators and replacement line ballasts; power rheostats; and a power resistor decade box. Clarostat Mfg. Co.

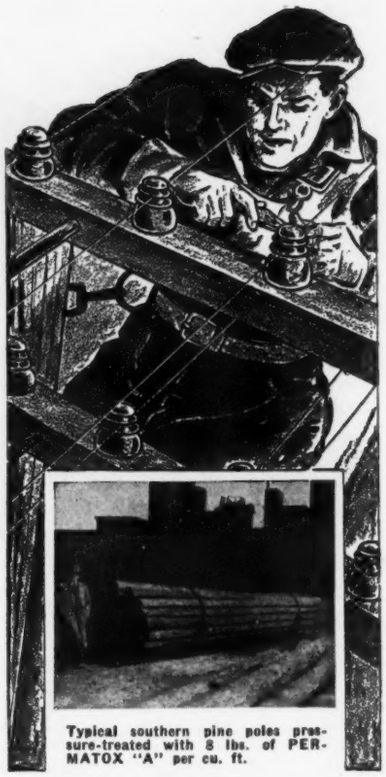
22 RADIO EQUIPMENT AND ACCESSORIES: Catalog titled "Everything in Radio and Electronics" contains over 10,000 parts, test units, batteries, radios and phonographs, public address and intercommunication equipment, recorders and accessories. Includes also communications receivers, kits, record changers, phonograph motors, tools, books, diagrams, and a large variety of other items in the electronics field for the radio serviceman and dealer, "Hams", experimenters, engineers, schools, and industry. Allied Radio Corp.

23 TESTING MACHINES AND ALLIED EQUIPMENT: Bulletin 161 describes and illustrates several types of testing machines, used among other applications for testing the tensile of wire and cable. Actual photographs illustrate each type of testing machine in operation. Structural and technical data are supplied. Diagrammatic drawings are also shown. The Baldwin Locomotive Works.

24 INSTRUMENTS: Catalog 245 covers complete line of electric measuring instruments. Detailed specifications cover ammeters, milliameters, voltmeters, millivolt-voltmeters, watt meters, frequency meters, power factor meters, tachometers, conductivity meters, telemeters, etc. Accessory equipment is also included. The Esterline-Angus Co., Inc.

25 PLUGS AND RECEPTACLES: Bulletin 47 features a line of plugs and receptacles for railway and air conditioning service. It includes heavy duty plugs and receptacles, automatic time switches, circuit breakers, heavy knife switches, insulators and line material. Description with an illustration of each type of equipment is given. Construction drawings are also shown. Albert and J. M. Anderson Mfg. Co.

26 PROTECTION HANDBOOK: A 24-page handbook contains suggestions to help you in selecting protective devices for electric circuits, motors, appliances and



Typical southern pine poles pressure-treated with 8 lbs. of PERMATOX "A" per cu. ft.

PERMATOX "A" HELPS KEEP DOWN POLE MAINTENANCE

Add years of useful life to new poles by treating them with PERMATOX A, a deep penetrating wood preservative. Order poles pressure-treated with PERMATOX A from convenient plants or use the vat soaking method to apply PERMATOX A to control shell-rot, decay and attack of termites or Lyctus (Powder-post) Beetls in poles, cross-arms and other heavy wood construction.

Old poles may be reclaimed by trimming away decayed or rotted portions and soaking, spraying or brushing them with PERMATOX A.

Furnished in Two Forms:

DOWICIDE 7
Pentachlorphenol* crystals

PERMATOX A
5% Pentachlorphenol* in suitable petroleum solvents

*Manufactured by The Dow Chemical Company

Write for Bulletin—Dept. E

A. D. CHAPMAN & COMPANY, INC.
333 N. Michigan Ave., Dept. E, Chicago 1, Ill.
Atlanta • Memphis • New Orleans • Houston
Los Angeles • New York • Portland • Chicago

cutting bacterial action in cutting oils

How Dowicides Control Microorganisms.

Metal working is one of many manufacturing processes which benefits from using Dowicides to control destructive bacteria.

Sulphur-digesting bacteria attack cutting oils and emulsions used in machining operations because the oils themselves may be sulphonated or stock being cut or ground may contain sulphur. The acidic by-products of the bacteria lower the pH of the emulsions, which results in the separation of the oil and water phases.

Widespread industrial experience has proved that Dowicides prevent bacterial destruction of cutting oils. Dowicides are produced in oil soluble and water soluble forms, so they may be used either in undiluted oils or emulsions.

Dow will help you select a Dowicide to meet specific needs—to control bacteria in cutting oils or to eliminate damage from microorganisms in any industry. Consult any Dow sales office—today!

DOWICIDE

germicides and fungicides

control termites mold and bacteria

DOWICIDES IN THE ELECTRICAL INDUSTRY

Effective preservative treatment of wood poles and cross arms is attainable with Dowicide 7 (Pentachlorphenol). Impregnation is achieved by heating the wood, followed by a cold bath in a pentachlorphenol solution. Dowicides also protect cotton braid covering and jute roving from dry rot and mold in overhead and underground cable installations.

THE DOW CHEMICAL COMPANY • MIDLAND, MICHIGAN

New York • Boston • Philadelphia • Washington • Cleveland • Detroit • Chicago • St. Louis
Houston • San Francisco • Los Angeles • Seattle

DOW

CHEMICALS INDISPENSABLE TO INDUSTRY AND AGRICULTURE

The CHAMPION **Fluorescent** and *Incandescent* Lamp distributor in *your* locality is the kind of distributor who knows that *your* best interests are *his* best interests. He has selected Champion Lamps for these practical reasons:

1 **Champion Quality** — guaranteed to equal or exceed Federal Specifications and backed up by the production resources and the forty-six years of lamp-making experience of one of the largest lamp manufacturers in the industry.

2 **Champion Economy** — the result of careful planning and specialization on the job of getting lamps to industry at minimum cost. The most lighting and the best lamps for your money is the objective of the Champion organization and the Champion distributor.

3 **Champion Service** — trained lighting experts in the field to cooperate with you and your supplier in order that you may be assured intelligent and efficient attention to your individual lighting and lamp needs.

Once you try Champion Lamps you'll appreciate these advantages offered you by the Champion distributor. May we give you his name and telephone number?

CHAMPION LAMP WORKS
Lynn, Massachusetts
A DIVISION OF CONSOLIDATED ELECTRIC LAMP CO

apparatus. Also includes a complete list showing size of fuse, fustat or fusetron to use. Handbook is replete with illustrations, charts, diagrams, and drawings. Bussmann Mfg. Co.

27 CERAMICS: Bulletin 645 is issued as an information piece showing the mechanical and electrical properties of a variety of ceramics. This is a folder which can be placed in a ring book. American Lava Corp.

28 ADJUSTABLE FLUORESCENT UNITS: Pull-out folder describes and illustrates several types of adjustable fluorescent lighting units which can be mounted from any angle. Some units are ceiling-mounted; others are mounted on walls, desks, or workbenches. Technical data are supplied, giving mounting heights. Test data of lamp's distribution also given. The O. C. White Co.

29 FITTINGS: Catalog 12G contains a list of entrance fittings, conduit bodies, flush switch fittings, vaporproof light fittings and explosion proof fittings. Illustrations and price lists are supplied. Killark Electric Mfg. Co.

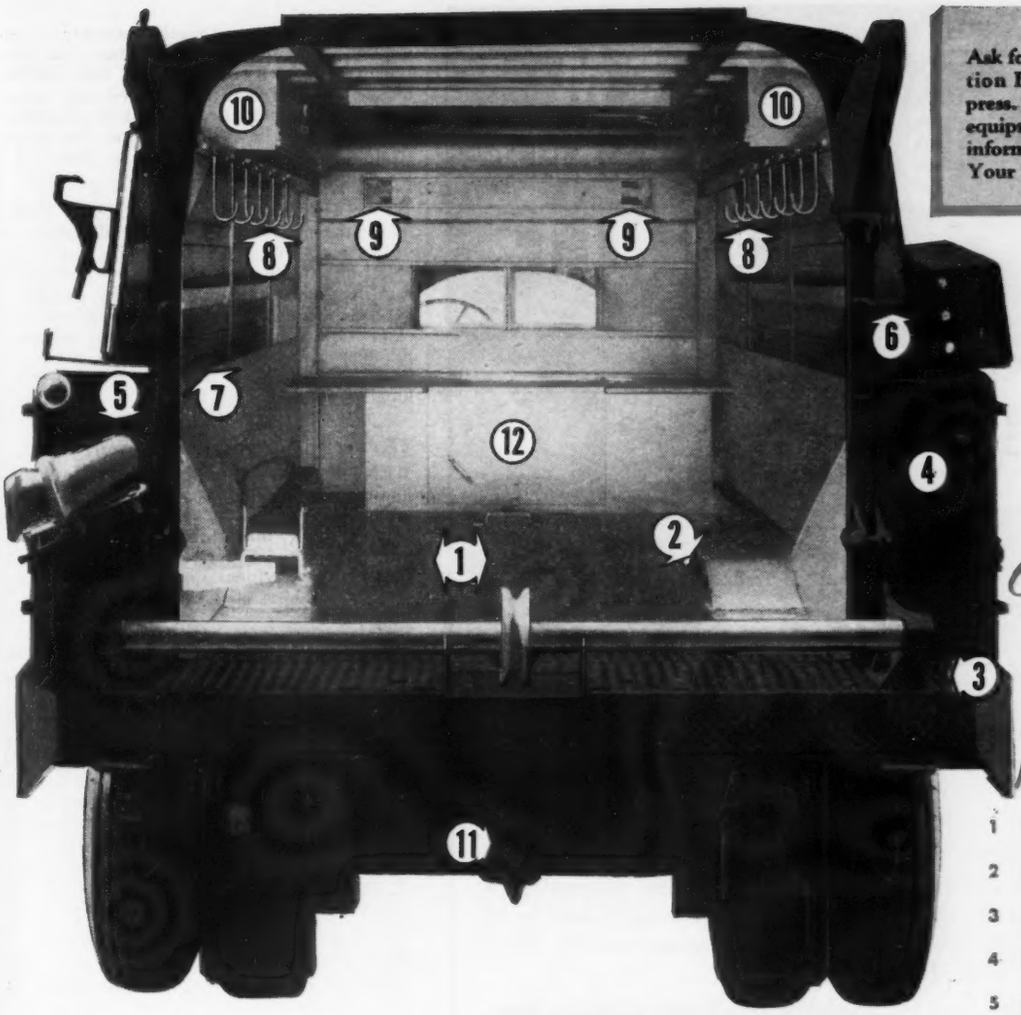
30 CIRCULAR WELDED PRODUCTS: Pull-out folder explains with illustrations the various uses of welded circular parts. A few applications are: generator, brake, clutch, and motor frames; wheel bases and gears for industrial trucks and starters; ball, roller and tapered bearing races; arc bars and manhole rings for marine boilers, etc. The American Welding & Mfg. Co.

31 BIMETALS: Folder discusses types of bimetals carried by this manufacturer. Technical data are furnished. Drawings, showing special shapes in which these bimetals are sold, are also given. Callite Tungsten Corp.

32 GRAPHIC INSTRUMENTS: Here is a collection of manufacturer's bulletins bound into one complete volume. It is a convenient source book of information dealing with the use of electrical instruments in generating plants, substations and in industrial plants. Each bulletin covers a specific application of manufacturer's equipment in field. Contains articles which reveal actual field experience with these timing and recording devices. The Esterline-Angus Co.

33 LAMPS: A 32-page illustrated booklet with ideas and suggestions for effective use of lamps in theaters is designed primarily for theater operators, engineers and technicians, architects and decorators. This booklet emphasizes particularly the new fluorescent circline and slimline lamps. It also contains large architectural pencil renderings and many more small lighting application and idea drawings. Incandescent sign lamps, fluorescent lamps, spotlights and floodlights for exterior and marquee lighting are discussed. Six pages of tables in the back of the booklet are specially designed to fit the needs of the theatrical industry and to aid in ordering lamps. Westinghouse Electric Corp.

34 TRUCKS AND ELECTRIC COACHES: Booklet features a variety of trucks; includes new designs, showing improvements over the pre-war models. Spe-



Ask for the new Line Construction Body folder just off the press. Shows dimensions, sizes, equipment, features, and other information of interest to you. Your copy mailed promptly.

Remember, we are always glad to see you at Cleveland . . . or feel free to call on our engineering trained *field men.*

the inside story on AMERICAN'S RENOWNED LINE BODY

How can so many diversified items be incorporated in a line construction body without cluttering space?

The *technical* answer is . . . scientific ratio of weight, strength, and durability. The *practical* answer . . . we know what you need and what you want. We should. We have been working side by side with utilities for these 30-odd years.

American has the know-how on design and construction. That's why American makes the DPL and DT Line Construction Body in six basic lengths . . . to take care of different requirements. And it explains why American will engineer bodies of special design when standard bodies will not serve the purpose . . . also why American offers a choice of more than 60 optional equipment items.

American bodies combine full utility value plus efficient design to give you low cost per mile operation. They outwear the chassis as much as 3 to 1.

Service with a smile—the American Body Type 4804 features two big compartments, 72" long x 12" wide x 14" high for mounting on any pickup body. Full carrying space inside the body. Full re-sale value of original equipment. Ask for prices on American Pickup and Service Truck side boxes and ladder racks. Good delivery.

Features

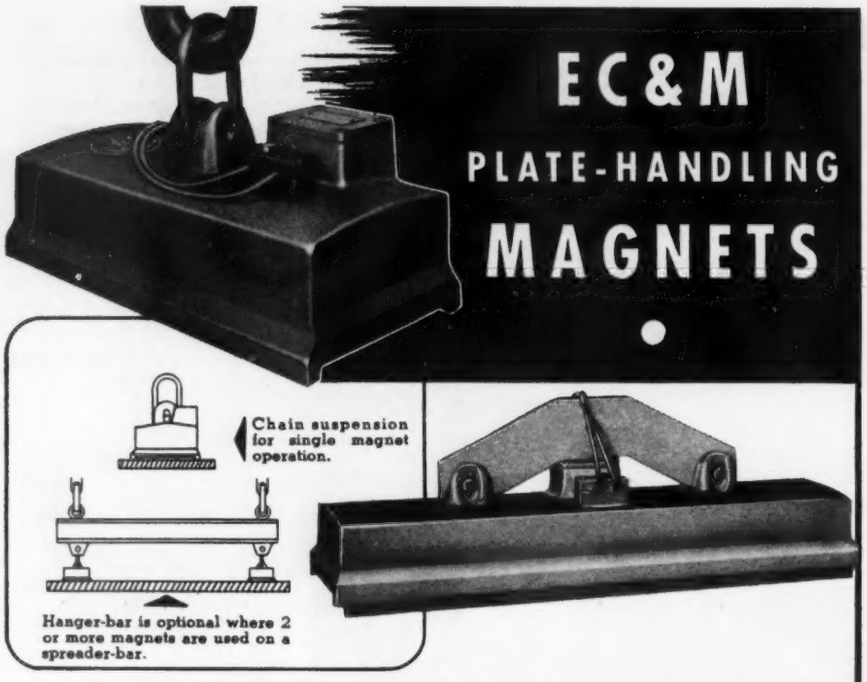
1 Low All Steel Floors
2 Flat-top Wheel Housings
3 Platform Extension
4 Roomy Compartments
5 Derrick Tunnel
6 Digging Tool Compartment
7 Full Length Inside Compartments
8 Swivel-type Material Hooks
9 Ventilating Louvres
10 Rubber Goods Compartment
11 Pintle Hook
12 Folding Winch Seat Cover

Plus!

. . . Weatherproof Roof Enclosure
Adjustable Ladder Racks
Through Boxes
Extended Sheave Bar Brackets
Non-Rattling Waterproof Doors

ACB and

THE *American* COACH and BODY COMPANY
9503 WOODLAND AVE., CLEVELAND 4, OHIO
"Baker American" . Baker Equipment Engineering Co., Richmond, Va. . Sales and Assembly


EC&M
PLATE-HANDLING
MAGNETS
Chain suspension for single magnet operation.
Hanger-bar is optional where 2 or more magnets are used on a spreader-bar.

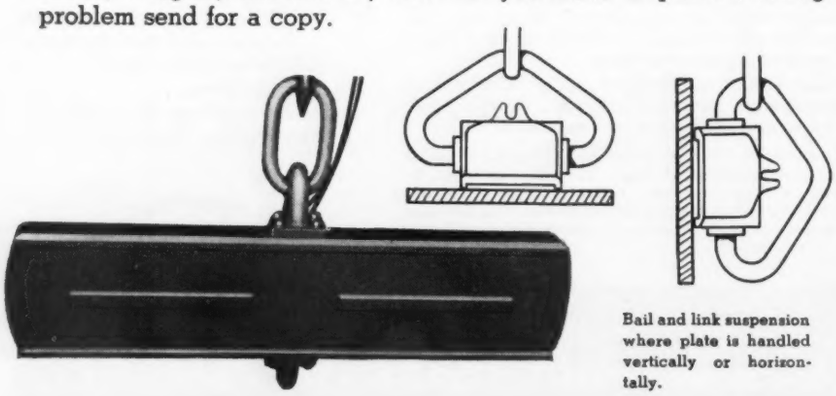
●These are EC&M Type P and Type F Magnets, designed specifically for handling sheet or plates, either cold or hot, at maximum temperature of 900 degrees or less. They can be worked singly for handling plates of medium-length. For longer plates, two or more magnets can be suspended from a spreader-bar and operated in parallel from one controller.

The advantages of these rectangular, plate-handling magnets are maximum lifting capacity with minimum magnet-weight, ability to handle material without groundmen and increased safety since prying plates apart to affix slings is eliminated.

These magnets are designed for operation on direct current power. Standard magnets have coils wound for 230 volt service. Optional windings for 115 volts and other voltages are available where required. Coils are furnished with either Class A or Class B insulation. Class B insulation is recommended for severe service and is essential for applications in which hot material is handled.

The standard controller for use with these magnets is the No. 0 Type with "Lift-Drop" Push Button Station. Where more than one plate is lifted at one time, operators quickly learn with this controller to be able to drop off plates one at a time until required number are lifted from the pile.

New Bulletin 903 gives complete information,—lifting-capacity tables, weights, dimensions, etc. If you have a plate-handling problem send for a copy.



Bail and link suspension where plate is handled vertically or horizontally.

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79th STREET • CLEVELAND 4, OHIO

cifications and construction drawings are included. In addition, it discusses an electrically operated trolley coach, designed for mass transportation in crowded city areas. Condensed specifications are shown together with a plan view drawing of the coach itself. Marmon-Herrington Co., Inc.

35 ELECTRONIC PRODUCTS: Booklet contains illustrations and descriptions of a variety of radio transmitting tubes and electronic equipment. Discusses complete line of vacuum tubes carried by manufacturer, including triodes, rectifiers, vacuum capacitors, vacuum switches, and diffusion pumps. Price of each unit is given in fly-sheet in back of booklet. Eitel-McCullough, Inc.

36 MATERIALS HANDLING EQUIPMENT: Bulletin features method of unloading hopper-bottom railroad cars of coal, coke, ore, minerals and other free-flowing bulk materials. Engineering details of equipment are discussed. Illustrations show typical application arrangements. Robbins Conveyors Inc.

37 OPEN CHANNEL METERS: Bulletin 62 discusses a type of open channel meters, designed to measure flow through any type of primary flow metering device which produces a single head representing rate of flow. Those meters may be used with all types of flumes, weirs and open flow nozzles to indicate, record, integrate and control the flow of sewage, industrial wastes, sludge, water and liquids with solids in suspension. Illustrations, diagrams and capacity curves are also shown. Bailey Meter Co.

38 PHOTOLAMPS: Bulletin 743P contains the latest phototechnical data on the complete photolamp line made by this manufacturer. Detailed exposure information is given. Also, photoflash and photoflood tables for use with all black and white and color films are included with a special section devoted to color photography with both standard and daylight-blue photoflash bulbs. Phototechnical production data covering standard and daylight blue photoflash and photoflood bulbs, photoenlarger bulbs and infrared heat drying lamps also given. Wabash Corp.

39 PERMANENT MAGNETS: A 36-page manual discusses the variety of applications for permanent magnets. Gives an historical background showing how and when magnets first were made. Technical details covering the basic types used in industry are also given. A table indicating characteristics of permanent magnet materials is included. Numerous illustrations present pictorially typical applications. The Indiana Steel Products Co.

40 INFRARED PROCESS: Brochure entitled "Infra-Red" discusses miscellaneous uses of infrared as applied to various industries. Topics covered come under the following headings: The Battle of Reconversion, Recommendation for Heat Processing, Factories From Coast-to-Coast, Now It Can Be Told, Baking Finish on Hot Water Heaters. Numerous illustrations show how infrared is used and the industries in which this is done. The Fostoria Pressed Steel Corp.

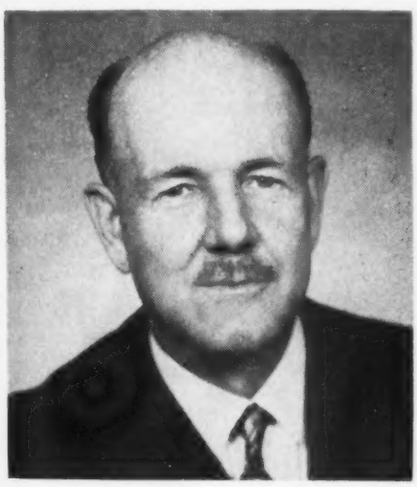
41 MAGNET AND RADIO WIRE: Catalog 246 is a revised edition of previous

NEWS ABOUT PEOPLE

C. P. Conrad Elected Head of Iowa-Illinois Utility

Commo. C. P. Conrad, Washington, D. C., has been named president of the Iowa-Illinois Gas & Electric Co., Rock Island, Ill., to succeed Frank L. Conrad of Chicago.

Commodore Conrad brings to the Iowa-Illinois staff a wealth of experience in



C. P. Conrad

both civilian and military life. Prior to entering the Navy in 1940, he was active in public utility management in Brazil, becoming chief hydraulic engineer of the Brazilian Traction Light & Power Co. in 1925. He later became assistant general manager and assistant to the vice-president.

His military service embraces two wars and a host of noteworthy accomplishments. He served as director of the entire Advance Base Department in the recent war and for this assignment he was decorated with the Legion of Merit medal.

•

▶ Charles E. Wilson, president of the General Electric Co., was awarded the honorary degree of Doctor of Laws by Syracuse University at the recent commencement exercises.

▶ Robert W. Carlson, chief engineer of the North Dakota Public Service Commission, has resigned, to open consulting engineering offices in Bismarck, N. D. He will specialize in the design of rural electrification lines in western North Dakota. Mr. Carlson had been identified with the commission since 1931, serving as assistant engineer, valuation engineer and then chief engineer.

•

W. E. Wood New President of Southeastern Group

William E. Wood, who was elected president of the Southeastern Electric Exchange at the recent meeting at Edgewater Park, Miss., became executive vice-president of the Virginia Electric & Power Co. in 1944 following the merger of Virginia Public Service Co., of which he was president, with the Richmond utility.

Back in the 1920's Mr. Wood had been associated with the Virginia properties as operating vice-president of the Virginia Railway & Power Co., which had been acquired by the Engineers Public Service Co. The name of the company was later changed to Virginia Electric & Power. He was then elected vice-president of the Engineers Public Service Co. with headquarters in New York. It was in 1941 that he was made president of Virginia Public Service.

Mr. Wood has been on many standing committees of the old National Electric

W. E. Wood

Light Association and its successor, the Edison Electric Institute, and has served as president of the Southwestern Public Service Association, the Virginia Public Utilities Association and is at present president of the Public Utilities Association of the Virginias.

M. C. Heffelman Made Head of New Mexico Utility

Announcement has been made of the election of M. C. Heffelman to the position of president of the New Mexico Power Co., Santa Fe, N. M. He was for-

M. C. Heffelman

merly vice-president and general manager and is continuing his services as general manager of the company.

Early in his career, Mr. Heffelman was connected with the Phelps Dodge Corp. and with the Chile Copper Co. in South America as supervisor of electrical equipment at Chuquimata, Chile. Upon his return to Arizona he was engaged by the Central Arizona Light & Power Co. for a period of four years, during which he was active in substation and plant design, power market surveys and rate studies. After a short affiliation with the Tucson Gas Electric Light & Power Co., he was named general manager of the Deming Ice & Electric Co. in 1933, was appointed vice-president and manager in 1940 and later in that year was advanced to the position of president and manager. He remained in active charge of the Deming property until 1942, when he was elected vice-president and general manager of New Mexico Power Co.

•

▶ Robert P. Liversidge has been appointed superintendent of the Southwark generating station of the Philadelphia Electric Co. After assignments in Ardmore and Richmond, he served as superintendent, electric distribution, western division; superintendent, gas distribution,

eastern division; acting superintendent and, later, superintendent, Barbadoes station, and in 1943 was made superintendent, Delaware station, the position he held at the time of his new appointment.

•

Ohio Edison Elects Miller, Moses Vice-Presidents

Harris E. Miller, manager of the Springfield Division of Ohio Edison Co., was elected a vice-president of the utility at a recent meeting of directors. Rufus Moses, Youngstown Division manager, was also elected a vice-president. Both men are directors of the utility.

Mr. Miller has been associated continuously with the electric light and power business in Springfield, his native

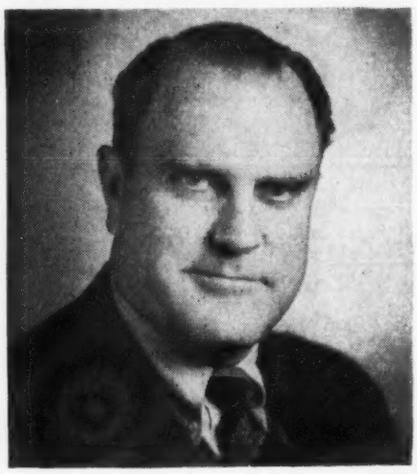
H. E. Miller

city, since his graduation from Wittenberg College in 1915. He was first employed by the Springfield Light, Heat & Power Co., a predecessor of Ohio Edison Co., as a meter tester. Advancing in the ranks, he became general superintendent in 1925 in charge of all physical property of the company, and in 1930 he was named general manager. When the Springfield utility was merged with electric properties in the Akron and Youngstown areas in 1930 to form the present Ohio Edison Co., Mr. Miller was named manager of the Springfield Division. He has been one of the leaders in practically every major community undertaking in Springfield for the past 16 years. During the war he served as chairman of the industrial salvage committee of the WPB for Clark County (Springfield), as well as being on the executive committee of the Civilian Defense Council, and chairman of its public utilities section.

Details of Mr. Moses' career were published in the January 5, 1946, issue of Electrical World, at the time he was made Youngstown Division manager.

Farrell Directs Sinclair's Accounts Div. Expansion

Expansion of Sinclair Refining Co.'s National Accounts Division under the direction of William F. Farrell has been



W. F. Farrell

announced by J. E. Dyer, vice-president. Under the expansion program, Sinclair plans to offer industry an improved and specialized service where such is required in solving operating problems of national accounts and in helping them to standardize and simplify their lubrication and fuel schedules. In adition to servicing national accounts, the National Accounts Division will also coordinate trade relations for Sinclair in that field under Mr. Farrell's direction.

Prior to his association with Sinclair in his present capacity, Mr. Farrell for years was a member of a leading New York Stock Exchange firm.

•

► William A. Conwell has been appointed general engineer in the structural engineering and design department, Duquesne Light Co., Pittsburgh. Mr. Conwell has been identified with Duquesne Light since 1937, and previously had been connected with the Pennsylvania Railroad and with Gibbs & Hill, Inc., consulting engineers.

► Harold P. Richmond, formerly general superintendent of operations for the Jersey Central Power & Light Co., Asbury Park, N. J., has joined the New York office of the Allis-Chalmers Mfg. Co., Milwaukee, Wis., as central station representative, specializing in all steam and gas turbine matters. Mr. Richmond became associated with the utility operating field in the summer of 1928 when, while still a student at Worcester Polytechnic Institute, he was employed by the United Electric Light & Power Co., New York, now Consolidated Edison Co. Following graduation in 1929, he became associated with the Eastern New Jersey Power Co., predecessor to the Jersey Central Power & Light Co. During his 16 years with this utility, he obtained a broad experience in all phases of power plant transmission and distribution line operations as well as manufactured gas operations. Mr. Richmond is a member of the American Institute of Electrical Engineers.

•

Miller Elected President of Federal Electric Co.

Linwood A. Miller has been elected president of the Federal Electric Co., Inc., Chicago, to succeed the late Charles Borland.

For the past four years Mr. Miller has been in government service as Deputy Regional Director of the War Produc-

L. A. Miller

tion Board and chairman of the Army Air Force Price Adjustment Board.

Prior to entering government service, Mr. Miller was president of the Willys-Overland Co., Toledo, Ohio.

•

► J. T. Jackson, formerly district manager of the Alabama Power Co. at Jasper, has been elected to the city's first commission. Mr. Jackson had been with the Alabama utility for 32 years. He was retired on April 1.

► T. R. Heikes, former superintendent of the American Falls power plant (Idaho) of the Idaho Power Co., has been transferred to Boise, where he will be supervisor of power plant operation and maintenance. Mr. Heikes has been engaged in power plant work for 22 years. For the past six years he has been at the American Falls plant, first as assistant superintendent and for the last four years as superintendent. L. E. Garlinghouse.

ARMATURE assemblies fit when C-D MICABOND insulating rings and segments are used. They fit because C-D manufacturing standards assure close tolerance production of MICABOND materials and parts. The consistent quality and accuracy of C-D MICABOND products justifies the confidence C-D MICABOND enjoys from the many manufacturers of armatures who specify C-D MICABOND. When your electrical insulating problem dictates "mica insulation," C-D engineers will be glad to help you to design to use mica to the best possible advantage—and in its most usable form—C-D MICABOND

KY-45

C-D PRODUCTS

The Plastics

DILECTO—A Laminated Phenolic.

CELORON—A Molded Phenolic.

DILECTENE—A Pure Resin Plastic Especially Suited to U-H-F Insulation.

HAVEG—Plastic Chemical Equipment, Pipe, Valves and Fittings.

The NON-Metallics

DIAMOND Vulcanized FIBRE

VULCOID—Resin Impregnated Vulcanized Fibre.

MICABOND—Built-Up Mica Electrical Insulation.

Standard and Special Forms

Available in Standard Sheets, Rods and Tubes; and Parts Fabricated, Formed or Molded to Specifications.

Descriptive Literature

Bulletin GF gives Comprehensive Data on all C-D Products. Individual Catalogs are also Available.

DISTRICT OFFICES

NEW YORK 17 • CLEVELAND 14 • CHICAGO 11

SPARTANBURG, S. C. • SALES OFFICES IN PRINCIPAL CITIES

•

WEST COAST REPRESENTATIVES

MARWOOD LTD., SAN FRANCISCO 3

•

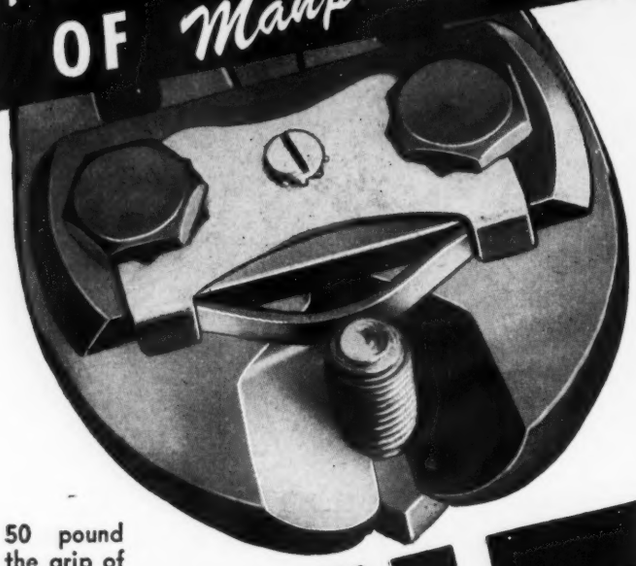
IN CANADA:

DIAMOND STATE FIBRE CO. OF CANADA, LTD., TORONTO

Continental-Diamond FIBRE COMPANY

Established 1895. . Manufacturers of Laminated Plastics since 1911—NEWARK 15 • DELAWARE

THIS TOOL MAKES
Horsepower OUT
OF Manpower



Multiplies 50 pound Pressure at the grip of the handles to approximately 4,000 pounds at cutting jaws to

CUT

BOLTS • RODS
WIRE • CHAIN
CABLE • FLAT STOCK

. . . on the job. Quick, durable, efficient. Used all over the world, 65 years of specialized experience in the making. Sold wherever mechanics' tools are sold. Write for illustrated catalog.

PORTER CUTTERS For Metals

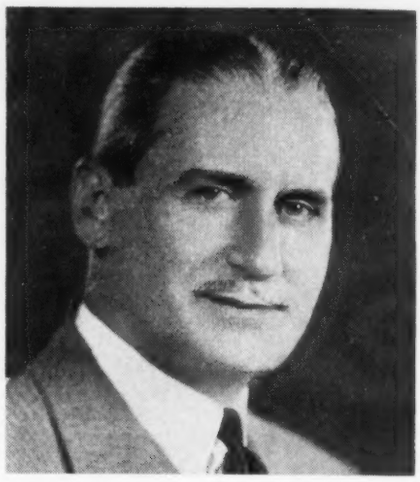
H. K. PORTER, INC., BOSTON 49, MASS.

formerly superintendent at the Swan Falls plant, succeeds Mr. Heikes at American Falls.

•

J. A. Seubert Elected Head of Estate Stove Company

John A. Seubert has been elected president of the Estate Stove Co., Hamilton, Ohio, recently acquired by Noma Elec-



J. A. SEUBERT

tric Corp. through its subsidiary, Triumph Industries, Inc. David Kahn, formerly president of Estate Stove, has been elected chairman of the board of directors. Mr. Seubert is also president of K-D Lamp Co., Cincinnati, another Noma subsidiary, and will retain both executive positions.

The following other officers were elected: vice-presidents, William A. Marshall, John Bess, Bertrand Kahn, Albert Kahn, Lucien Kahn, Stanley Bernhardt; secretary, Robert Goldman; treasurer, J. B. Wharton, Jr.

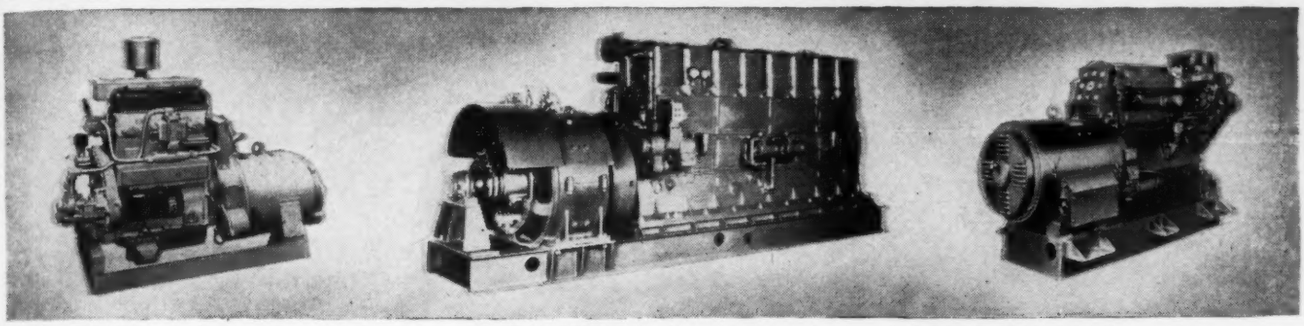
Mr. Seubert stated that Mr. Marshall, a vice-president of Noma Electric Corp., will be in charge of Estate's manufacturing operations and Mr. Bess will direct its sales and advertising.

•

▶ EDWARD TONKIN, for more than 30 years in the electrical field, has joined the Standard Switchboard Co., Brooklyn, N. Y., as sales manager.

▶ JOHN W. DELIND, JR., has been elected president of the Borg-Warner International Corp., with headquarters in Chicago. He succeeds R. W. GIFFORD, who becomes chairman of the board of the International corporation, while ARCH BLACK has been named vice-president in charge of appliances and J. L. CUNNINGHAM vice-president in charge of automotive parts. Mr. DeLind brings to Borg-Warner a wide background of export experience in the appliance, industrial and

BUILDING GENERATORS
TO FIT THE ENGINE...
Our Business Since 1891



Burke Type wa, DC Generator Buda Diesel Driven.

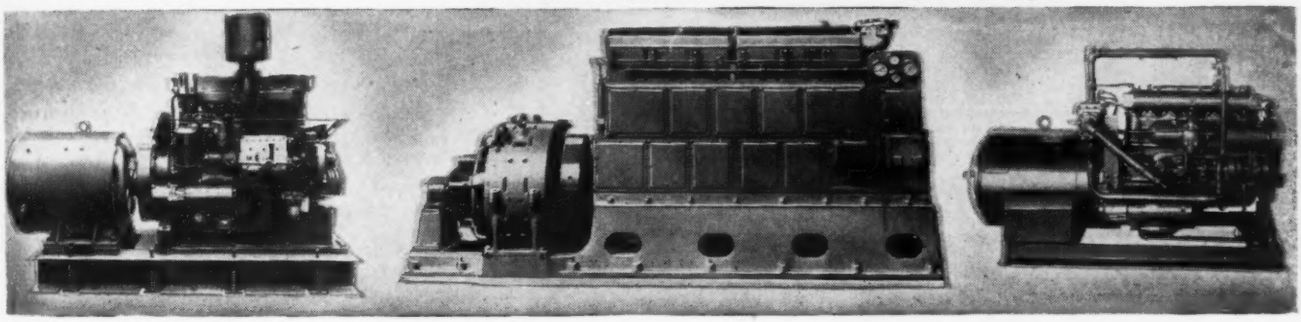
Burke 40 kw, DC Marine Type Generator.

Burke 150 kw, DC Generator Driven by Atlas Diesel.

Burke 150 kw, 450 RPM — DC Generator for Marine Diesel Engine Drive.

Burke 30 kw, DC Generator Driven by Cummins Diesel.

Burke 30 kw, DC Generator Driven by Hercules Engine.



ENGINE builders find Burke a dependable source for specially built generators. Hundreds of Burke generators are teamed up with leading engines to produce efficient power units for the job.

Burke as one of the oldest and largest independent builders of AC & DC generators has over 55 years of specialized experience in this field. When you purchase an engine-generator unit, make sure your generator measures up to the engine you select — ask for Burke generator recommendations, for it's our business to design and build the best generator for the engine of your choice.

For a description of the complete Burke line of AC and DC motors and generators, consult Sweet's Engineering catalogs or Electrical Buyers Reference catalog.

For immediate assistance, contact our nearest representative:

ATLANTIC ENGINEERING CO.
185 17th Street, N. E., Atlanta, Ga., Phone: Hemlock 6461

J. T. COOPER
Room 1515 Engineering Bldg.,
205 West Wacker Drive, Chicago, Ill.,
Phone: Franklin 5061

C. E. WINCHELL
205 Perry-Payne Bldg., Cleveland, O., Phone: Cherry 5634

CARL D. MILLER
Roosevelt Theatre Bldg., Detroit, Mich.,
9595 Gartiot Avenue, Phone: Plaza 7232

J. B. COLESWORTHY
1709 West 8th St., Los Angeles 14, California
Phone: Federal 2021

MAXWELL-JONES-KELLETT INDUSTRIES
740 S. Caliborne Ave., New Orleans 13, La.,
Phone: Raymond 8241

L. B. RITCHIE
Room 1704, 274 Madison Ave., New York, N. Y.
Phone: Lexington 2-5330

B. A. AUERBACH
Room 234, 1600 Arch Street, Philadelphia, Penna.,
Phone: Rittenhouse 5226

F. E. BURKE
416 Maple Ave., Pittsburgh, Penna., Phone: Penhurst 5357

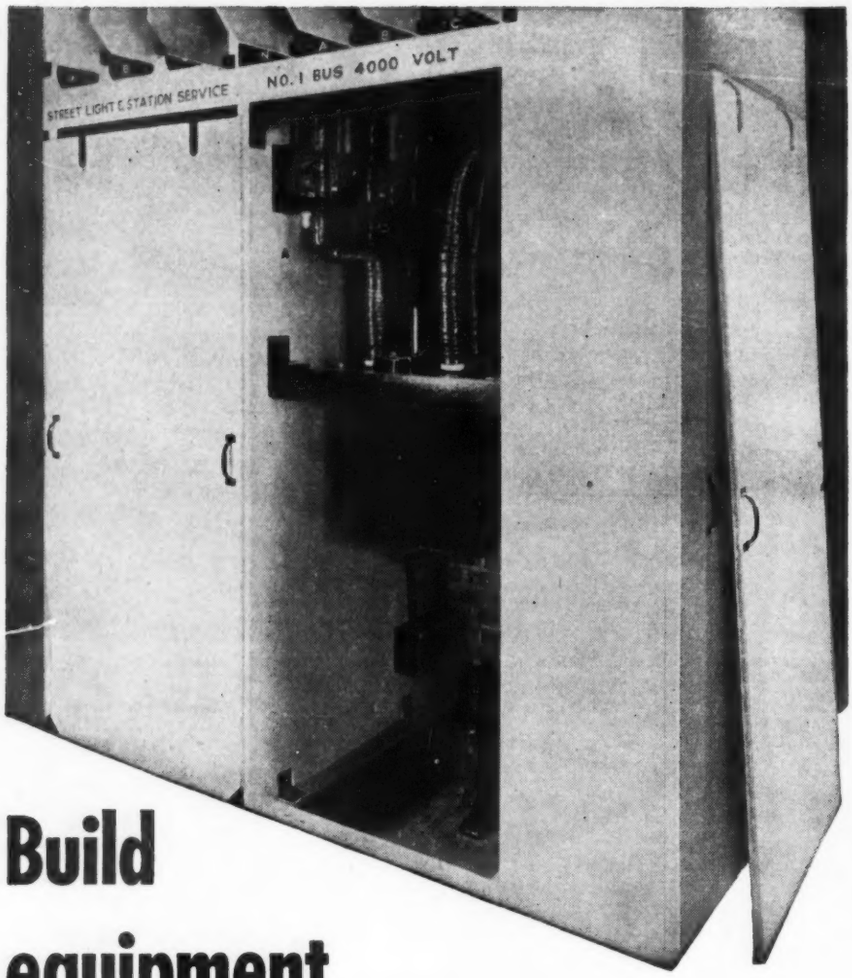
P. A. MORSE
Morse Engineering Co., Room 600
Fullerton Bldg., St. Louis, Missouri, Phone: Garfield 0076

RALPH JAMES—Northwestern Agencies, 2411 First Ave., Seattle, Wash., Phone: Elliot 8882

MOTORS 1 TO 1500 H. P. • GENERATORS 1 TO 1000 K. W.

BURKE A.C. & D.C. Motors & Generators

BURKE ELECTRIC COMPANY, ERIE, PENNSYLVANIA • *Since 1891*



Build equipment housings *the size you want* with J-M TRANCELL

WHEN you build equipment housings with Trancell, you can have all the working space you need—and the size of housing you want.

Easily workable, Trancell comes in large, ready-to-install sheets that can be cut, drilled and bolted on the job ... or Johns-Manville will supply it cut to your dimensions. Trancell provides tough, permanent housings for all types of high voltage equipment ... it needs no paint, requires little upkeep. A complete line of hardware is available for Trancell Doors.

Light weight and space-saving, Trancell doesn't overload balconies and upper floors ... though strong, it is of minimum thickness, takes up less room when used for barriers and bus-bar housings. An asbestos product, it is rotproof, rustproof, and fireproof—confines oil fires to the cells of origin. Its low conductivity protects adjacent equipment from heat transmission.

For complete details, write Johns-Manville, Box 290, New York 16, New York.

Johns-Manville TRANCELL
an asbestos product ... for housing electrical equipment

automotive fields. Recently, as director of exports, he organized the export program for the Crosley Corp. in Cincinnati.

•

Westinghouse Announces New Engineering Appointments

Westinghouse has recently made several new engineering assignments in various districts.

FRANKLIN L. SNYDER has been appointed engineering manager of the Sharon transformer division. A graduate of Gettysburg College, class of 1923, Mr. Snyder has been employed by the company since that time, joining the transformer division in 1925. A year ago he was awarded the company's Order of Merit. A. C. FARMER, who for the past five years served as assistant to the late H. V. Putman, vice-president and manager of the transformer division, has become assistant to John K. Hodnette, manager of the Sharon transformer division.

WILLIAM G. MILLER has been appointed manager of the headquarters manufacturing staff at Pittsburgh, Pa. In the new position, created to effect a closer coordination in the management service given the operating divisions, Mr. Miller will be responsible for the headquarters manufacturing activities of the equipment, manufacturing engineering, production, quality control and wage incentives departments. He joined Westinghouse in 1933.

DAVID W. R. MORGAN, manager of the steam division, has been appointed general manager of the entire South Philadelphia Works. Mr. Morgan's responsibilities will include general supervision of the aviation gas turbine division, and the Attica, N. Y., plant of the stoker department. He will retain direct management of the steam division.

FREDERICK S. BACON, JR., has been appointed manager of the central station division in the New England headquarters offices in Boston. Mr. Bacon joined the company in 1936 after being graduated from Northeastern University, and has been assistant manager of the central station division since 1941. He is chairman of the Boston section, A.I.E.E.; vice-president of the Massachusetts Society of Professional Engineers and past-president of the Tri-County Electric Association.

To further plans for expanding export trade to Australia, the Orient and western South America, R. H. MACGILLIVRAY has been appointed regional supervisor of the Pacific Coast area for the Westinghouse Electric International Co., headquarters in San Francisco. Prior to assuming the newly created position, Mr. MacGillivray was regional export supervisor in Washington, D. C., where during the war years he helped meet the

Tested for four Years . . . .

Back in 1941 our engineers had completed the design of a new street-lighting control which unfailingly insures adequate illumination regardless of changes and fluctuations in weather and the twilight hour.

Wartime obligations prevented production, but for four years the engineers' prototypes have been tested under actual street-lighting conditions . . . time-proven, it is now offered as our

SUNSWITCH
LIGHT CONTROL

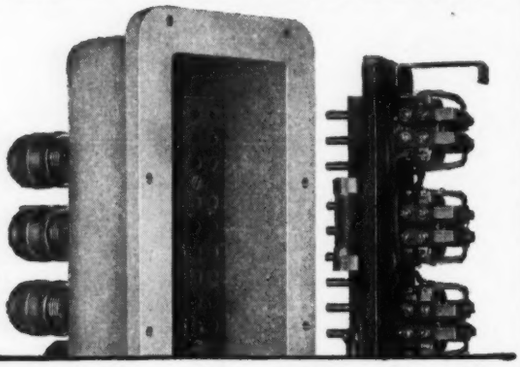
A practical and rugged unit with 100 percent safety factor . . . its sturdy components assure a negligible maintenance cost. Tooling up for large scale production is now completed. Write for Bulletin No. 8239.

The SUNSWITCH can also be used to control illumination of public buildings, outdoor advertising, airport beacons, radio mast running lights, and ships' running lights

The **RIPLEY** *Company*

20 NEW LITCHFIELD STREET **TORRINGTON, CONNECTICUT**

for...
Complete Protection



Specify
UNILARM

the Unit Alarm System
. . . ready to Install

Unilarm combines in one compact unit the many features essential for complete supervision of all types of electrical and mechanical process control.

Saves valuable space, reduces engineering and installation costs to a minimum.

Plug-in panel cuts maintenance and provides continuous alarm protection.

Test switch gives instant proof of Unilarm's readiness to function under alarm conditions.

Flashing alarm signals every departure from a predetermined normal condition.

Available for panel or surface mounting.

BULLETIN U-46
gives wiring diagrams, dimensions, prices and complete information.
Write for your copy today on your business stationery.

EXPLOSION-PROOF . . . . . DUST-TIGHT
VAPORTIGHT . . . . GENERAL PURPOSE

Since 1902

RUSSELL & STOLL COMPANY, INC.
PRECISION BUILT ELECTRICAL EQUIPMENT
125 BARCLAY STREET • NEW YORK 7, N. Y.

51

electrical requirements of the Allied Nations by making Westinghouse equipment available to foreign government missions in cooperation with United States government agencies. He joined Westinghouse in 1922 as an industrial sales engineer.

OBITUARY

▶ GEORGE S. HAYES, director and purchasing agent of The Okonite Co., Passaic, N. J., died on May 3 at the Community Hospital, Montclair, N. J. Though in his 82nd year, Mr. Hayes remained active in his business associations until stricken with pneumonia two weeks ago. His early business career started in Boston, he then went west, returning to the east in 1908. In 1911 he joined The Okonite organization in order to undertake the purchase and operation of their rubber plantation in British Guiana, South America. When the plantation was sold in 1918 Mr. Hayes returned to the United States and assumed the duties of purchasing agent for the company. He was also elected a director of The Okonite Co. in 1923 and continued to serve in these capacities until his death. Mr. Hayes was also purchasing agent for the Okonite-Callender Cable Co., Inc., Paterson, N. J., and the Hazard Insulated Wire Works Division of The Okonite Co., Wilkes-Barre, Pa.

▶ EDSON R. NORRIS, formerly associated with the Westinghouse Electric Corp., died on April 28 at his home in Pittsburgh, Pa., at the age of 74. When he retired in 1936, Mr. Norris had completed 44 years of continuous service with Westinghouse, in the manufacturing and equipment phase of the business. At the time of his retirement he held the position of assistant to general works manager at East Pittsburgh.

▶ RICHARD BROWN, 51, chief engineer of steam stations, Boston Edison Co., died at Wellesley Hills, Mass., on April 29, after a brief illness. He was born in Cambridge, Mass., was graduated from Worcester Polytechnic Institute in electrical engineering in 1920, and for four years was connected with the then Worcester Electric Light and American Steel & Wire companies in that city. He joined the Boston company in 1924 as head of the mechanical technical division in the production department. In 1931 he was transferred to the L Street station in South Boston as assistant to the chief engineer of steam plants, becoming assistant chief engineer in this category in 1937 and chief in 1940.

▶ JOHN A. HENNING, public utilities superintendent at Lodi, Calif., died April

ROCKBESTOS A.V.C. SLASHES

CIRCUIT MAINTENANCE IN HOT SPOT INSTALLATIONS

You can't effectively baffle the steady blast of heat given off by boilers and steam lines that dries out, bakes brittle and cracks open wire and cable insulation — and as long as you burn coal, its sulphurous, rotting fumes are going to complete the job of setting up circuits for failure.

But you can practically eliminate the cost of replacing cable that is failing too often in hot spots by wiring with Rockbestos A.V.C., because it is *permanently insulated* with asbestos to resist heat and corrosive fumes. What's more important, you can protect boiler feed pumps, induced draft fans, coal grinding mills, exhausters, precipitators and other essential equipment against operational failure.

The maintenance-eliminating cable illustrated is one of 125 designed by Rockbestos to give trouble-free service under severe operating conditions. It is also made up with lead sheath or armor and in a three-conductor construction — and there are many others for power, control and lighting circuits in 600 to 5000 volt ratings that will save you money in circuit maintenance. Write for a catalog and learn why.

ROCKBESTOS A.V.C. 600 VOLT POWER CABLE

Nat. Elec. Code Type AVA

max. operating temp. 230°F.

Permanently insulated with impregnated felted asbestos and covered with a heavy asbestos braid to resist the destructive effects of heat, corrosive fumes, flame, oil and grease — this cable is typical of 125 wires and cables developed by Rockbestos to give long-lasting, failure resisting service under severe operating conditions. The same type is made in 1000, 2000, 3000 and 5000 volt ratings.

Others in the line include Switchboard Wire, Motor Lead Cable, Secondary Network Cable, Fireproof Vault Cable, Multi-Conductor Cable and Lead Sheathed or Armored constructions.

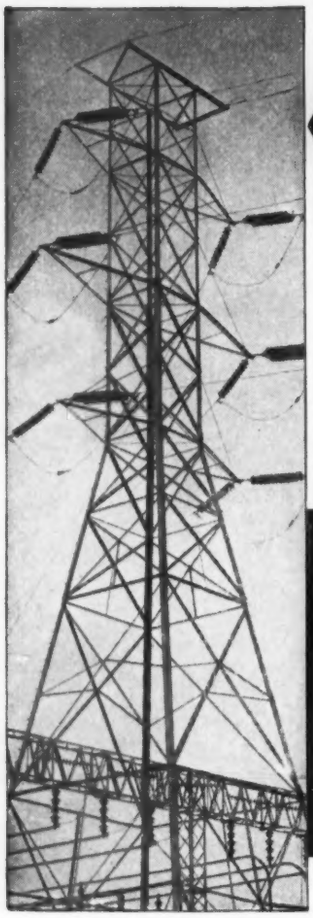
ROCKBESTOS PRODUCTS CORPORATION

136 NICOLL STREET, NEW HAVEN 4, CONN.

ROCKBESTOS A.V.C.

The Cable with Permanent Insulation

NEW YORK BUFFALO CLEVELAND LOS ANGELES PITTSBURGH CHICAGO ST. LOUIS SAN FRANCISCO SEATTLE PORTLAND, ORE.



DILLON DYNAMOMETER

A multitude of Dillon Dynamometers are protecting communities and companies alike from failures caused by wires going down in severe storms. Standard for dependable accuracy, simplicity and convenience. Actual size 8¼" x 6¼" x 3". In wide use also in telephone and telegraph work for indication of tension in guy strands, messenger and wire. Many other uses where torque, weight and overload are vital factors. Take out guesswork of "sight and sag". Hooked on in a jiffy, indicates tensions in seconds. Direct reading. Nine capacities, 500 to 20,000 lbs. There's a place for the Dillon in every Electrical Plant.

Send for illustrated Dynamometer Manual.

W. C. Dillon & Co., Inc.
5423 W. HARRISON ST. CHICAGO 44, ILL.

Most electricians know that Gold Seal sticks tighter anywhere because there's more lasting tackiness in the friction compound – more tensile strength in the fabric. Gold Seal Tape won't dry out or smear in any weather – won't ravel or peel. It's laboratory-tested at every step, and it comes to you factory-fresh, cellophane wrapped and boxed. If you don't already use Gold Seal Tape – try a roll! Jenkins Bros., Rubber Division, 80 White Street, New York 13.

Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet ASTM and Federal specifications.

JENKINS Gold Seal Tapes
FRICTION and RUBBER TAPES

MADE BY JENKINS BROS . . . MAKERS OF FAMOUS JENKINS VALVES

15. He was 71 years of age. Superintendent of Lodi Municipal District since 1910, the year in which it was founded, Mr. Henning also had been actively identified with the California Municipal Utilities Association.

▶ ANTON BORTENLANGER, co-founder of the Platte Valley Light & Power Co., died recently at his home in Valley, Neb., at the age of 71. With his brother, he founded and operated the company from 1916 until it was incorporated in the Nebraska Power Co. in 1921.

▶ EDWARD DAVIS, formerly head of the Philadelphia Storage Battery Co., predecessor to the Philco Corp., died on April 19 in Boston after an illness of several months. He was 86 years of age.

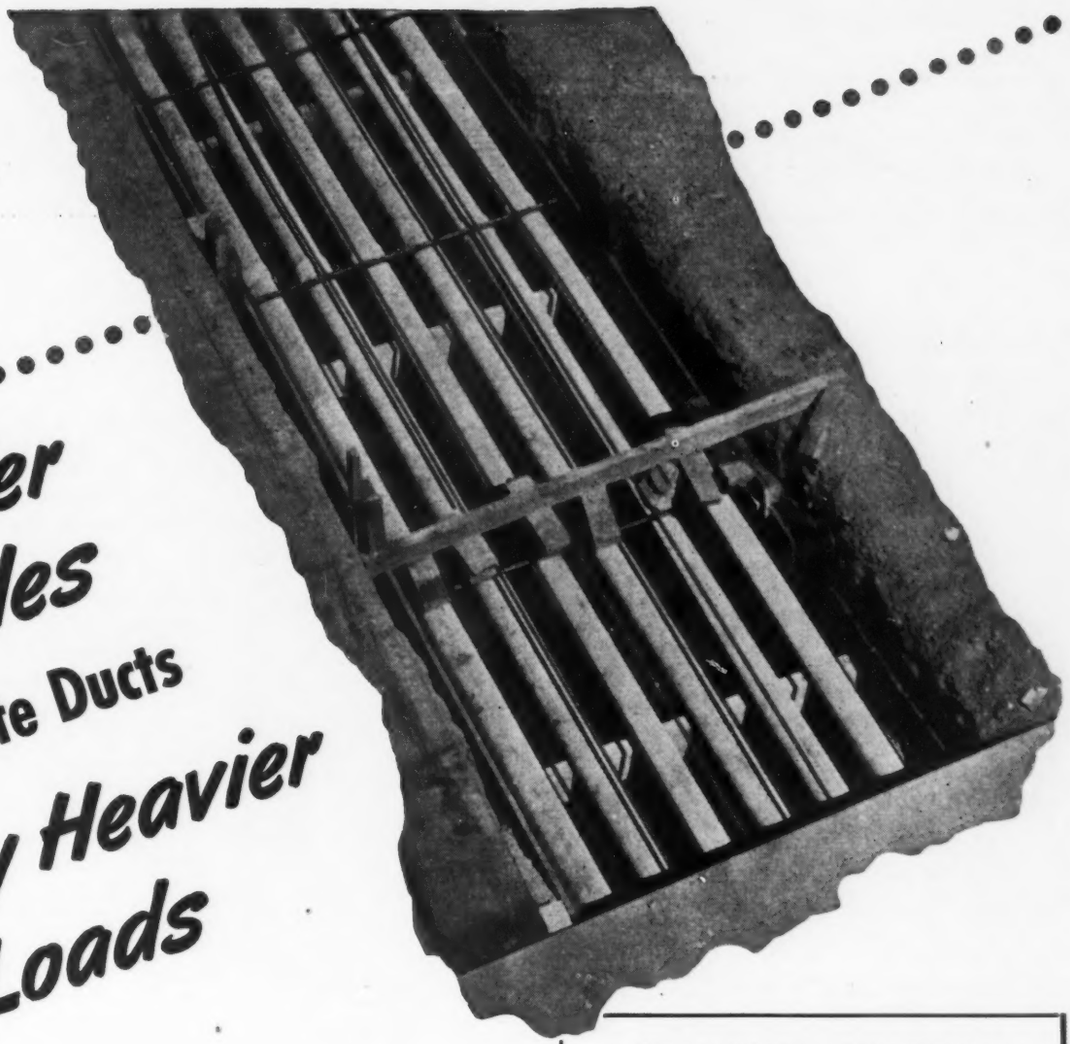
▶ DR. GILBERT N. LEWIS, one of the nation's leading chemists and scientists, died of a heart attack on March 23 in Berkeley, Calif. He was 70 years of age. Born in Weymouth, Mass., he was graduated from Harvard University in 1896. Dr. Lewis collaborated with Dr. Ernest O. Lawrence in inventing the cyclotron, or atom-smasher, and with Dr. Irving Langmuir was co-author of the Lewis-Langmuir atomic theory. He had written on and contributed extensively to atomic and molecular theory.

▶ DONALD D. SERVOSS, an electrical engineer with the Buffalo Niagara Electric Corp. for 26 years, died at his home in Buffalo, N. Y., recently of a heart attack. Mr. Servoss was 50 years old. He was in the utility's distribution planning department.

▶ ANDREW G. SMITH, for 30 years an employee of the Westinghouse Electric Corp., died on April 4 in Cleveland, Ohio, after a short illness. A native of North Dakota, he received his engineering degree from the University of North Dakota in 1914. Considered an expert on small motors, he was the author of a technical treatise, "Application and Service of Small Motors."

▶ JOHN J. ROSS, outstanding radio manufacturer and head of Aviola Radio Corp., died in Los Angeles, March 14 at the age of 48. Born in Odessa, Russia, Mr. Ross came to America in 1918. He was founder and operator of the Detrola Radio Corp. at Detroit, Mich., until 1942, when he went to California to retire. However, in 1943 he established Aviola Radio Corp. in Los Angeles for manufacture of radar and other equipment. Recently he had purchased the surplus Air Research plant at Phoenix, Ariz., for mass production of radios, phonographs and similar goods under the Aviola name. His death was attributed to a brain hemorrhage due to mental strain.

Cooler Cables in Transite Ducts Carry Heavier Loads



Increases of as much as 15% in current carrying capacity have been measured in cables sheathed in Transite Ducts!

The figures in the test case illustrated, made by Johns-Manville Research Engineers in collaboration with several leading cable engineers, apply to a single Transite Duct compared with an organic duct.

Transite Ducts have been proved to dissipate I^2R losses 13% faster than other ductways tested, thus keeping cables cooler. Higher load capacity, reduced copper losses and increased cable insulation life are the results.

Made of asbestos and cement, Transite Ducts are strong, immune to rust and rot. They are incombustible and unaffected by electrolysis or galvanic action. A permanently smooth bore makes possible long cable pulls and easy replacements. Long, lightweight lengths can be quickly and economically installed. In addition, a full line of fittings simplifies even the most complicated installations.

HOW TRANSITE DUCTS INCREASE CABLE CARRYING CAPACITIES

Tests made on a lead-sheathed 500,000 CM cable insulated with ½" paper and placed inside a single duct encased in concrete.

Sheath Temperature, 145° F.
Ambient Air Temperature, 90° F.

CURRENT CARRYING CAPACITY

Transite Duct	796 amperes
Organic Duct	691 amperes
Difference	105 amperes

(Figures are results of tests conducted in the J-M Laboratory in collaboration with several leading cable engineers.)

For full information on Transite Ducts, write for Data Book DS-410. Johns-Manville, Box 290, New York 16, New York.

Johns-Manville

TRANSITE DUCTS
CONDUIT for use without concrete
KORDUCT for concreting in

MANUFACTURERS & MARKETS

Westinghouse Negotiates $80,000,000 Bank Loan

Funds To Be Used For Expansion And Operating Needs—Studying Financial Program—Strike a Factor

To meet immediate financial obligation and to proceed with the company's $58,000,000 improvement and expansion program, Westinghouse Electric Corp., is now negotiating an $80,000,000 bank loan, Gwilym A. Price, president, announced recently.

Stating that the management "is also studying the advisability of a more permanent type of financial program such as debenture bonds or a capital stock issue," Mr. Price disclosed that the bank loan had become effective May 1 and would be for a two-year period, with an option to renew for three additional years. The company has bank loans of $30,000,000 in war-time V-credits which fell due May 1, he said.

Operating loss for the first quarter will be "substantial," Mr. Price revealed, with net sales billed during the first three months averaging $10,000,000 a month, compared with $57,000,000 for the same period in 1945.

He said it was impossible to give a complete report on the business for the quarter, during most of which the plants were idle as a result of the prolonged strike.

The Westinghouse executive disclosed that the company's cash and marketable securities at the end of March amounted to $111,000,000, nearly the year-end total, principally because of "such cash receipts as $72,000,000 in payment for products shipped before the strike and about $23,000,000 in advance and final payments on terminated war contracts." Expenditures of $97,000,000 were made for payrolls, services and materials, taxes and the purchase of a plant at Buffalo, N. Y., he stated.

"Even after the strike has ended," Mr. Price continued, "for approximately two months we shall have to meet payrolls and buy materials out of working capital, because it will be at least that long before we shall begin to collect payment for goods manufactured and shipped." Despite anticipated increases in sales volume and a backlog of orders of about $400,000,000, he added, "it will be difficult for the company to maintain earnings at a level near that of its normal operations in the past."

•

Shallcross Acquires Attenuator Production

Culminating six months of cooperative planning and association, Shallcross Manufacturing Co., Collingdale, Pa., has acquired the manufacturing rights and licenses to produce Variaten attenuators, gain sets, and other resistance devices manufactured by the Cinema Engineering Co., Burbank, Calif. According to an announcement by D. H. Shallcross, general manager of the Shallcross Manufacturing Co., production has already begun at the Collingdale plant.

Mr. Shallcross states that Cinema Engineering Co. will service as field engineers for Shallcross in the Southwest.

•

Steber Moves to New Plant

Larger production capacity and more convenient shipping facilities are provided by the new plant at 2701 N. Pulaski Road, Chicago, into which the Steber Manufacturing Co. has recently moved.

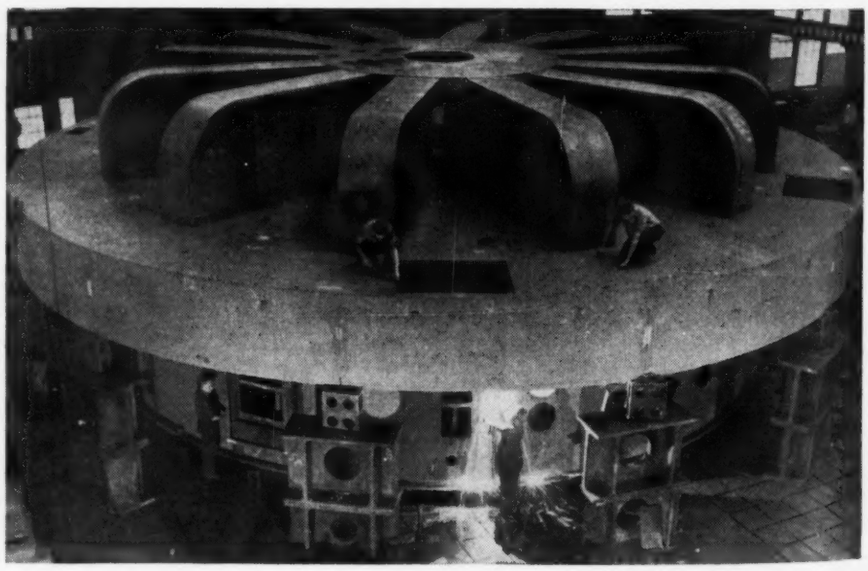
First Dnieprostroi Units Now Being Shipped

Among the first of the pieces of heavy apparatus going to Europe to rebuild the war damaged electrical systems is the 90,000-kva. hydroelectric generator for Russia's Dnieprostroi Dam. This is the first of three designed for that project and these are reported as the largest in physical size ever built.

The frame diameter is 42½ ft. and the weight more than 2,250,000 lb. These new units have an increased rating of 16 percent over the 77,500-kva. machines built by this company in 1931 for the same project. They are also larger than the generators at Boulder Dam, which have a rating of 82,500.

Dnieprostroi was completed in 1932 at a cost of $110,000,000. Although in 1941 the Nazis reported that the Russians had destroyed the dam and equipment, later investigation disclosed that they had only short-circuited the generators and removed vital equipment. Actual destruction was carried out by the Germans during their retreat.

Rebuilding of the dam started in 1944 and it is expected that these new generators will be producing power early in



ASSEMBLED FOR FIT—Stator frame of the first of the Dnieprostroi units is shown in trial assembly at the General Electric plant in Schenectady. The machine was later disassembled and is now "on its way" to Russia. The rectangular outlets in the top of the hood are for discharging the warm air from the generator into the power station

No electrical equipment can be any better than its insulation

This insulating varnish helped shipyard electrical equipment operate under wartime overload.

G-E INSULATING VARNISH 9435

A black baking varnish . . . highly flexible . . . good resistance to moisture and chemicals . . . recommended for manufacture and maintenance of machine tool motors

. . . and the same varnish can help to keep peacetime industry's electrical equipment on the job.

IN the field of insulating varnishes the General Electric label stands for 45 years of experience in research and manufacture . . . large productive capacity . . . expert technical service. G-E Insulating Varnishes, which were supplied in millions of gallons for the toughest war uses, now are available to all industry. You can count on uniformity of product in every shipment because of strict G-E Quality Control in every manufacturing operation. For full details consult your local General Electric Merchandise Distributor. Or write direct to Section RIMA-5613, Resins and Insulation Materials Division, Chemical Department, General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC

CD46-14

G. E. OFFERS A COMPLETE LINE OF INSULATING MATERIALS

1947. The major parts of the first of the three are now being shipped and constitute components of the machine which will produce the first power at the dam.

•

Square D Splits Stock; Company Prospects Bright

Stockholders of Square D Co. at the last annual meeting approved the splitting of the company's common stock three shares for one for a total of 1,377,480 shares outstanding, and authorized a total of 2,000,000 shares of common stock, the balance of which will be maintained in the treasury for use if expansion of the company is deemed warranted at a future date.

The split-up was recommended by the directors inasmuch as they felt it would result in a broadening of the ownership of the company, and to adjust the company's capital so that it would be commensurate with Square D's size, volume of business, the value of its permanent assets and the amount of its working capital.

Although the company faces many problems, the long range outlook indicates favorable operation for the predictable future, F. W. Magin, president reported.

"Square D's electrical control and distribution equipment volume," he said, "is holding up extraordinarily well and the company now has a backlog of orders which is the largest in its history. Allowing for the possible inflation caused by over-ordering by customers, our backlog still is sufficient to insure satisfactory operation of our electrical divisions for some time, and other new business is developing constantly."

Square D's Kollsman Division, which develops and manufactures a variety of types of aviation, navigation, and aerological instruments, has weathered the changeover from strictly war production to peace-time manufacture and its prospects are bright, Mr. Magin said.

•

New Operational Set-Up

Announcement has been made by the American Transformer Co., Newark, N. J., of a new operational plan and personnel appointments, designed to streamline the manufacture and merchandising of its products.

The three essential product line sections operate under the following supervision: Electronics and aircraft products, John F. Harris; power distribution and liquid-filled transformers, Walter Hoehn, and specialty air-insulated transformers and transtats, Theodore W. Stauber.

Any Electrical Promotion Helps All, States MacDonald

Each Benefits by Action of the Other in Advancing Electrical Living—Analyzes Market Breakdown

All phases of the electrical industry benefit by the promotion and growth of any individual section or division, stated N. J. MacDonald, Thomas & Betts vice-president and chairman of the general sales promotion committee of the National Electrical Manufacturers Association, at the National Electrical Wholesalers Convention held recently in Chicago. In fact, he continued, it behooves the electrical manufacturer, wholesaler and retailer to cooperate with the utility in promoting electrical living.

The industry is interdependent, he pointed out, and continued, "I can give you a typical illustration of the practical working of electrical interdependence. It is estimated that when an electric range is sold, an electrical billing of $186 is made. The range manufacturer gets $71 for his range and $115 goes to others in the electrical industry. With an expected sale of at least one million ranges a year, a volume of $186,000,000 for our industry results. Here is about how it breaks down, and note how it cuts right across practically all branches of the industry, the manufacturer, the utility, the wholesaler, the dealer and the contractor:

Generation of Electricity	$40,000,000
Transmission and Switching	10,000,000
Substation	21,000,000
Primary Feeders	3,000,000
Secondary Distribution	24,500,000
Service Entrances	7,500,000
Material Purchased to Build Ranges	9,000,000
Sale of Ranges	71,000,000
	$186,000,000

"And, that's only part of the story. Out of the $71,000,000 that the manufacturer of the ranges gets, he buys from other members of the electrical industry, in order to build the one million ranges:

Incandescent Lamps	$4,800,000
Lamp Sockets	5,600,000
Fluorescent Lamps	400,000
Fluorescent Starters and Ballast	400,000
Switches of all types	6,800,000
Fuses	1,350,000
Fuse Blocks	1,350,000
Porcelain Blocks and Insulators	2,000,000 lbs.
Timers	750,000
Thermostats	1,000,000
Wire Terminals	4,000,000
Locknuts	6,000,000
Copper and Lead Wires	125,000,000 ft.

And many others, not to mention millions of pounds of stainless steel, aluminum, copper alloys, nickel and chrome alloys, silver contacts, magnesium oxides, porcelain frets, etc. I don't know how much electrical equipment and apparatus is required to support that consumption, but I do know that it's plenty.

"This analysis of the business generated for all branches of the industry through the sale of electric ranges is simply typical of many similar stories we will use to support and illustrate the Electrical Interdependence idea."

He then charged each segment with doing its duty in promoting this idea and concluded, "I believe that the Declaration of Electrical Interdependence points to the solution of our industry problem. If each one of us in every branch of the industry puts it to work *now*, we'll begin to build an almost endless highway of demand for electrical living. And in my opinion, the Electrical Wholesalers, representing the most economical means of mass distribution yet developed, are right out in front in this program."

•

Film Shows Welding Advances by Animation

Preview of General Electric Co.'s new all-color, sound movie, "This Is Resistance Welding," was shown in the General Electric Building in New York recently. The movie is part of the company's "More Power to America" program.

The film emphasizes the important role resistance welding is playing in America's production. There is a detailed explanation, in non-technical terms, of the operating principles of resistance welding. Animated drawings and close-ups are included.

The four principal types of resistance welding—spot, seam, projection, and flash welding—are shown in interesting detail, and the film reveals how quantity production is made possible by the efficiency of modern resistance welding machines with their accurate controls.

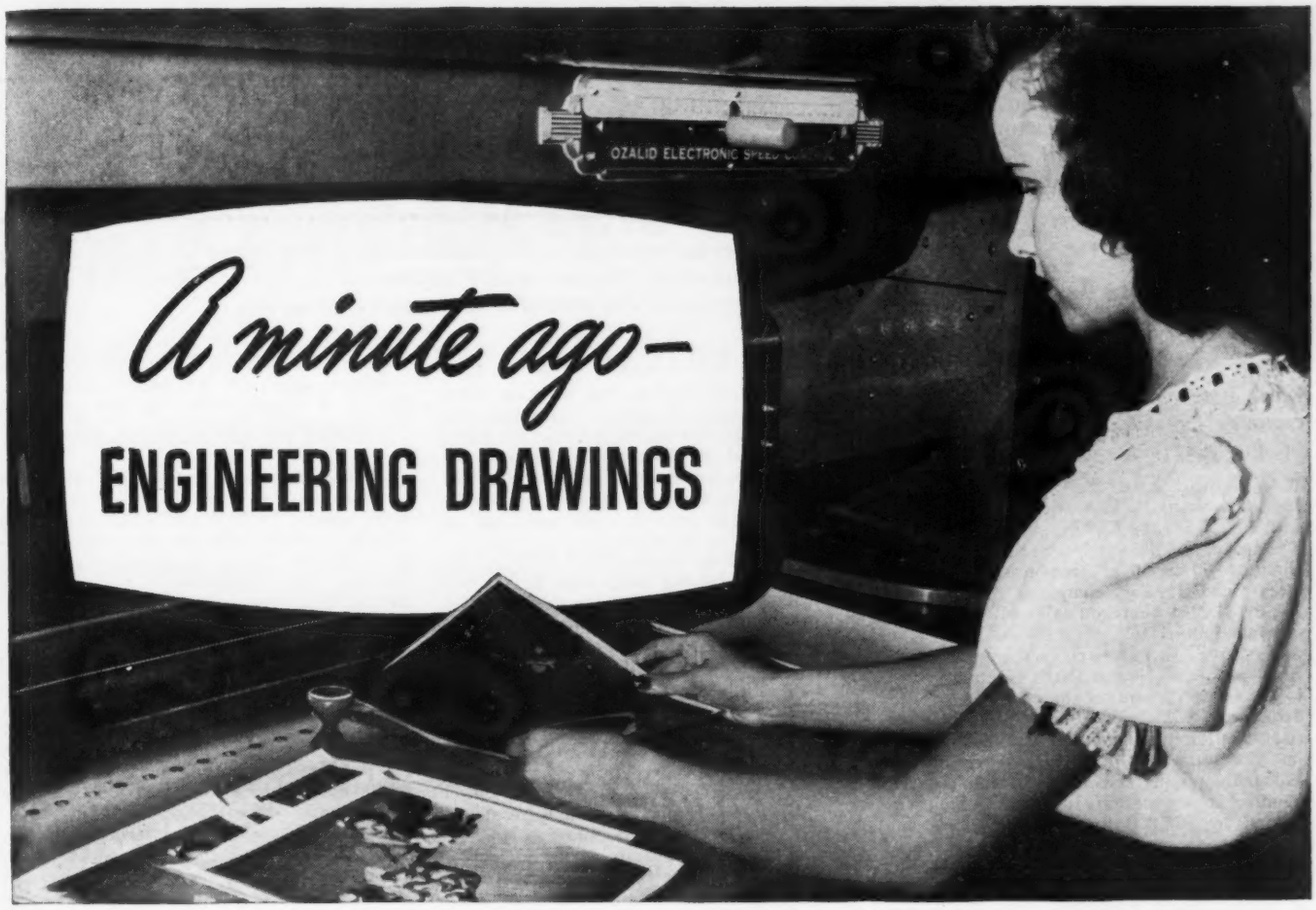
The film requires about 30 minutes to run and is available for loan without charge to interested groups.

•

Electric Industry to Join All-Industry Conference

All branches of the electrical industry in the Cleveland area are indicating their interest in joining in the All-Industry conference which the Electrical League of Cleveland is sponsoring June 5 in the Hotel Statler.

The meeting, first of its kind this year, will deal with future sales training pro-



AND NOW it's photographic material that's being reproduced . . . in the same OZALID machine, in exactly the same manner.

You see the operator feeding the "MASTER" and a sheet of Ozalid sensitized material into the machine. That's all that has to be done.

In just twelve seconds a beautiful positive copy will be delivered—dry, ready for immediate use—like the prints on the feedboard.

It's the same quick, simple routine when you're reproducing engineering drawings, office forms, or typed reports. And, in addition, there's this important advantage, realized only with OZALID:

You can select any one of ten different types of Ozalid material . . . and reproduce the lines or images of your original in the color you prefer—black, blue, red, or sepia . . . and on the base you prefer—paper, cloth, foil, or film.

Thus, you can always match the print to the job at hand!

For example, in reproducing continuous-tone photographic subjects, you'll probably use OZALID DRYPHOTO, which gives you lustrous prints with all the tonal values present in the original. Just the thing for unique advertising displays or dramatic presentation of your products in sales catalogs.

Available now are OZALID MACHINES for large, medium, and occasional print production requirements.

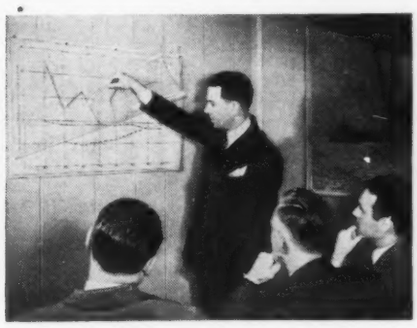
• • •

Whichever model you choose, you have the same versatility.

Want form letters that look like original typing?

Your customers and prospects won't know the difference, and you'll cut time and labor costs to a fraction.

Just have the original typing done on a translucent letterhead and make Ozalid Rapid Black prints directly from it. On these, fill in the headings and references with the same make of typewriter used to prepare original.



Want transparent overlays in different colors?

Artists labored for days to do what can now be done in minutes.

Instead of applying inks or paints to nonabsorbent surfaces, you simply draw individual details in pen or pencil on separate sheets of translucent paper . . . and reproduce each on an Ozachrome film of the desired color. The job is finished by merely overlaying the Ozachromes in register.

Learn the complete story . . . and see samples of the ten types of Ozalid prints you will be able to make. Write today for free booklet No. 96.

OZALID

Division of
GENERAL ANILINE AND FILM CORPORATION
JOHNSON CITY, NEW YORK

Ozalid in Canada
Hughes Owens Co., Ltd., Montreal

grams, the prophesied $23,000,000 electrical market, and ways in which the Cleveland Electric Illuminating Co. and the Electrical League will cooperate with dealers, distributors and manufacturers to develop it.

•

Manufacturers Issue Earnings Reports

Electrical manufacturing companies which have recently issued statements of earnings covering 1945 operations are the following:

ANACONDA WIRE & CABLE—Net profit, $646,324, equal to $1.53 a share, compared with $1,225,282, or $2.90 a share in 1944.

BRIDGEPORT BRASS—Net profit, $810,081, equal to 75 cents a common share on net sales of $53,162,258, compared with $1,246,352 or $1.21 a share on sales of $63,038,679 the year before.

HALL (C. M.) LAMP—Net profit, $115,701, equal to 65 cents a share, compared with $128,265, or 72 cents a share, for 1944 after deducting $7,812 additional provision for renegotiation for 1943 and $225,000 reserve for renegotiation for 1944. A refund of $235,000 was agreed upon in final settlement of renegotiation for 1944, which exceeded by $10,000 the provision made for that year.

CANADIAN WESTINGHOUSE—Net income, in Canadian currency, $1,541,155, equal to $2.69 a capital share, compared with $1,495,141, or $2.74 a share in 1944.

NATIONAL BATTERY—Nine months to January 31, consolidated net income, $690,000 after charges and taxes, equal to $2.06 a share on the capital stock outstanding, compared with $630,000, or $1.88 a share, in the nine months ended on January 31, 1945.

NATIONAL POLE & TREATING—For 1945, net income $49,591, against $75,062 in 1944.

•

Reuland Small Motor Division Sold to Rheem

Rheem Mfg. Co. has purchased the small motors division of Reuland Electric Co. Howard Reuland stated that for the present his company would devote its entire facilities to the production of 1-hp. and over sizes.

•

Opens Technical Section

International Nickel Co., Inc., has announced the opening of the Empire State Technical Section of its Development and Research Division, located in the Genessee Valley Trust Building, Exchange and Broad Sts., Rochester 4, N. Y. It will furnish technical information and assistance to industry in the State of New York, excluding New York City, the Albany area and the Hudson River Valley. Gilbert L. Cox, metallurgical and chemical engineer, will be in charge. He has been associated with International Nickel since 1931.

FIELD REPORTS ON BUSINESS

Lighting sales are extremely active, considerable modernizing of street lighting being done in many areas. Despite upward adjustment of prices of wiring and conduit, supplies are scarce. The most critical situation is in copper.

CHICAGO

Electrical wholesalers are marking time, with an extreme scarcity of supplies persisting despite upward adjustment of prices of wiring and conduit. Strikes in coal and copper have nullified any benefit which might have been expected from the price revision—estimated at 13 percent. The most critical situation is that in copper.

Speakers at the International Lighting Exposition here predict more than $1,000,000,000 will be spent for new store and office lighting equipment in the next five years, involving the greatest store modernization program ever seen, and an unprecedented increase in the rate of opening of new stores.

Allied Control Co., manufacturers of electrical fittings, has purchased the structure built for it during the war by DPC. Radionic Control, Inc., has moved to West Chicago to secure larger quarters. Consumers Power Co., Muskegon, Mich., plans a huge steam-electric plant in 1947. Preliminary plans call for a 120,000-kw. capacity plant.

Industrial building in the Chicago area is at a low ebb, while at the same time plant space is scarcer than at any time in history. There is an estimated backlog of $400,000,000 in industrial building, including equipment, despite the fact that the government spent $1,200,000,000 for new plants in the 1940-45 period.

NEW ENGLAND

Cambridge Electric Light Co. plans to build a new 18,000-kw., high-pressure steam and electric plant for power and industrial heating service in the eastern section of Cambridge. Central Vermont Public Service Corp. has contracted to supply 173.5 hp. in service to the L. W. Webster Co. sawmill at Randolph, Vt. This company has completed a 2.5-mile rural line between Rochester and Stockbridge, 17 miles of such lines in Northfield, and has received four carloads of poles and a carload of wire in connection with building two miles of 44-kv. transmission and some rural construction in the Windsor division.

Lighting sales are very active in Massachusetts. Braves Field, Boston, has been equipped with new lighting for night ball playing; the installation consists of 768 1,500-watt floodlights mounted on eight poles which give 200 foot-candles on the infield, and 175 foot-candles on the outfield. Plans for equipping Fenway Park with similar lighting are under consideration. Plans have been approved for street lighting on Sea St., Quincy, Mass., consisting of 125 lamps rated from 6,000 to 10,000 lumens.

Pullman Standard Car Co., Worcester, Mass. has received an order for 100 air-conditioned trolleys for Atlanta, Ga., deliveries to commence about June 15. According to an announcement by William Leavitt Stoddard, New England Industrial Development Corp. president, contracts totaling more than $1,000,000 for oil-burning apparatus, telephone parts, and copper products have been placed with a company that is planning a Massachusetts location in which to operate; in addition $10,000,000 worth of electronic apparatus has been contracted to New York companies by this new company.

PACIFIC COAST

Though crippled by strikes in such eastern factories as Westinghouse and Bryant and with General Electric and other recently restored locations still far from normal output, Pacific Coast electrical wholesaling business was nevertheless good in April, averaging 10 percent above last year.

Bids for material required by many western projects such as Colorado-Big Thompson, Kendrick-Seminoe in Wyoming, and Davis Dam, downstream from Boulder, shipments for which latter will clear through Kingman, Ariz., will be received from May 10 to 24 after having been several times postponed. Outstanding items are for five 62,200-hp. turbines for Davis and one 165,000-hp. turbine for Coulee Dam.

General Electric was awarded five 800-amp., 196-kv. circuit breakers and five 1,200-amp. disconnects for the Shasta and Keswick power houses of California Central Valley project which with arresters and instruments totaled $221,194. The Bonneville System is also very active, recent preliminary awards having covered $136,070 for clearing the Chehalis-Olympia 30-mile, 230-kv. right-of-way and $69,932 for the 115-kv. Albany-Toledo sector. Pelton Water Wheel bid $1,049,325 for six Grand Coulee pumps.

A survey has recommended nearly 300 intersections equipped with electrical traffic signals gradually replacing those already installed. Pacific Gas & Electric Co.'s new substation at 8th and Mission together with two similar installations to serve the homes and new industries of the equally crowded East Bay will cost more than $11,000,000.

NEW YORK

Electrical manufacturers, wholesalers and retailers are increasing their field sales forces in the New York area and getting ready to go after business. Manufacturers increased sales forces 1.4 percent during the last month, electrical wholesalers expanded their sales forces more than any other wholesale group and the retailers are signing up returning servicemen and other salesmen who have had previous experience.

Traffic appliances and electric ranges are beginning to appear in increased numbers and several concerns state that these will be moving at pre-war levels by the end of the year if the labor situation eases. Wholesalers and retailers are most anxious about refrigerators and the greater percentage state that these should appear in time for Christmas gifts.

Shortages are still plaguing the trade, but ballasts and sockets have eased somewhat. There is no stock available, but the items have begun to appear in the market again. Wire is beginning to become increasingly short because of the strikes. Pole line hardware poles are reported to be increasingly tighter because of the steel and creosote famine.

WHAT FIRE-KILLER

squeezes through the tightest spots to smother "can't-be-reached" blazes?

Quick-Reading Facts About Kidde Trailers

Q. *What equipment does a Kidde Trailer carry?*

A. Kidde Trailers are built to specification. A typical unit carries hose reel with 300-pound supply of carbon dioxide; two 15-pound Kidde portable carbon dioxide extinguishers; two Kidde water extinguishers.

Q. *What motive power is needed for a Kidde Trailer?*

A. A light truck, jeep, or even a passenger car will pull the Trailer.

Q. *What power source is needed to discharge the carbon dioxide?*

A. None! It is discharged entirely by its own stored energy—no pumps or other equipment needed.

It's carbon dioxide, of course!

Carbon dioxide swirls around obstructions . . . penetrates through cramped spaces . . . to reach, *and kill,* the most inaccessible fires.

Take underground cable blazes, for example.

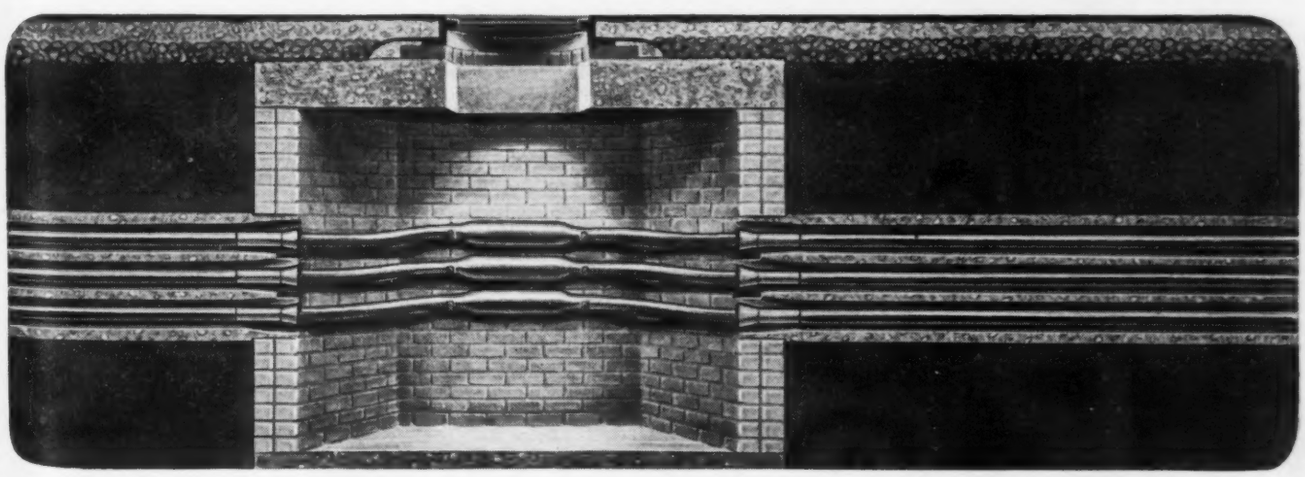
Bring a Kidde Trailer Unit to the scene. Shoot the carbon dioxide down the nearest manhole.

The gas quickly works its way through the underground ducts to stamp out the fire at the point of origin.

And . . . the dry, inert gas cannot damage cable insulation, cause short circuits, or corrode metal.

The Kidde line includes equipment for the fast, effective extinguishing of fires in any type of electrical equipment. Ask a Kidde representative for full details.

Walter Kidde & Company, Inc.
530 Main Street • Belleville 9, New Jersey



K Kidde

Kidde

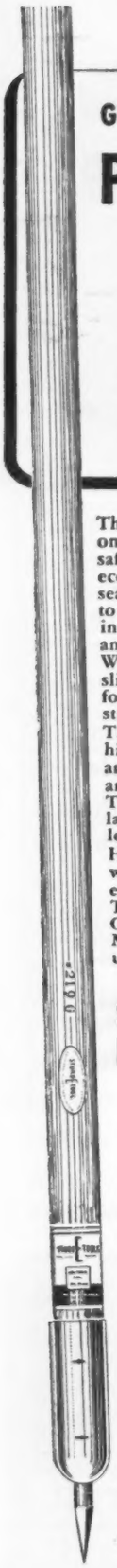
The word "Kidde" and the Kidde seal are trade-marks of Walter Kidde & Company, Inc.

Give your crews the

Protection

of this

STURDE Guarded Pike Pole



The patented, automatic shield on this SturdE pike pole is a safety feature for your men—an economy feature for you. The seamless steel tube slides down to protect the point when not in use, guards it against damage and prevents accidents to crews. When action starts, the guard slides back, and *locks* to reinforce the ferrule and give added strength.

The 8¼ in. spike is forged from high grade steel, heat treated and tempered for hard service, and can be easily repointed. The fir handles are sanded and lacquered, and come in five lengths, 12 to 20 feet.

Here's a sturdy, long-life tool with a safety feature that adds extra value. Manufactured by The American Fork and Hoe Company, Cleveland, Ohio, Makers of True Temper Products.

STURDETOOLS
a TRUE TEMPER PRODUCT

Exclusive SturdE feature — Automatically released tubular shield is easy to operate, locks into place and reinforces head when pole is in use. Slips down to protect point for carrying and storing.

Distributed by

JOSLYN MFG. & SUPPLY COMPANY

20 North Wacker Drive • Chicago, Illinois

Branches and Warehouses with Complete Stocks in Principal Cities of the United States

SALES OPPORTUNITIES

MINNESOTA—American Crystal Sugar Co., Boston Bldg., Denver, Colo., has made application to CPA, federal agency, for permission to proceed with erection of proposed new beet sugar mill near Moorhead. It will comprise a number of one and multi-story buildings, with machinery for processing and other service, and electrical equipment for large capacity. A power plant will be built. Entire project is reported to cost close to $4,000,000. Completion is scheduled early in fall of 1947.

TENNESSEE—Town Council, Lebanon, will receive bids until May 29 for new outdoor-type switching station, and extensions and improvements in electrical distribution system, as per plans and specifications on file. William M. Wilson, Shelbyville, is consulting engineer.

OREGON—Bureau of Reclamation, Denver, Colo., will receive bids until May 24 for four motor-driven pumping units, with control equipment, etc., for installation in Adams pumping station, main division, Klamath project, Oregon-California. Equipment will be installed by government (Specifications 1285).

PENNSYLVANIA—Pittsburgh Crucible Division of Crucible Steel Co. of America, Inc., Oliver Bldg., Pittsburgh, has authorized large expansion program at mill at Midland, comprising new bar mill, furnaces and other units. Cost reported about $6,000,000. Work will be placed under way soon.

CALIFORNIA—Hynes-Clearwater Ornamental Lighting District, Hynes, plans installation of new ornamental street-lighting system on Paramount Blvd., in vicinity of Hynes. Cost estimated about $80,000.

CALIFORNIA—Bureau of Reclamation, Denver, Colo., will receive bids until May 24 for three 16-ft. by 17-ft. 3-in. radial gates, with 5-in. dia. rollers, pin bearings, etc.; three 15,000 radial gate hoists, with motors, limit switches, reduction gears and accessories for Little Dry Creek siphon, Friant-Kern Canal. Also, for two similar size radial gates with 5-in. dia. rollers, pin bearings, etc.; and two 15,000-lb. radial gate hoists, with motors, limit switches, reduction gears and accessories for Little Dry Creek wasteway, Friant-Kern Canal. All equipment will be installed by government (Specifications 1311).

ILLINOIS—Electro-Motive Corp., Division of General Motors Corp., La Grange, diesel locomotives and parts, has plans maturing for superstructure for new steam-electric generating station for works service, on site at Brookfield, near La Grange, and will take bids on general erection contract at early date. Cost reported close to $2,000,000, with equipment. Schmidt, Garden & Erikson, 104 South Michigan Ave., Chicago, are architects.

INDIANA—Inland Steel Co., Inc., 38 South Dearborn St., Chicago, Ill., has authorized expansion at mill at East Chicago, comprising number of new units for increased output of cold-rolled steel strip and other

It's YOUR future— Make the most of it!

Start now to earn the bigger pay in electrical repair

Was there ever such an opportunity to get started in electrical maintenance and repair—and at top-notch wages? Are you ready—with experience and ability—to cash in on it? Others are getting just the sort of background needed—quick! practical!—to handle the great variety of electrical maintenance and repair work TODAY—from this well-known electrical library. You can too!

Electrical Maintenance and Repair Library

5 volumes, 2042 pages, 1721 illustrations

Gives you the "know-how" to tackle any wiring or motor job. Five books show you HOW—to install all types of motor and generator units—to inspect and repair motor starters and generators—to diagnose motor and generator troubles—to figure new windings for old cores, DC and AC windings—to test armature windings, test induction motors, etc., etc. The new book is full of trouble-shooting charts that show quickly symptoms, causes, specific remedies, etc.

Includes trouble-shooting book

Now in addition to four well-known practical books on all details of testing, connecting, rewinding, installing and maintaining electrical machinery, the Library includes Stafford's *Troubles of Electrical Equipment*, a handy book giving helpful maintenance information, special trouble-shooting charts, explanations of symptoms and causes of machinery troubles, specific remedies, etc. This revised library gives you the ability to handle bigger jobs with surety of results.

10 DAYS' EXAMINATION
Easy Monthly payments

We want you to examine this Library for 10 days. If you don't want them at the end of that time, there's no obligation to keep them. On the other hand if you decide you want the help these books can give, start the small monthly payments then, and in a short time the books are yours, right while you have been using them. Send the coupon today.

EXAMINATION COUPON

McGraw-Hill Book Co., Inc.
330 W. 42nd St., New York 18, N. Y.

Send me Electrical Maintenance and Repair Library, 5 volumes, for 10 days' examination. If I find the books satisfactory, I will send you $1.00 in 10 days, and $3.00 a month until $15.00 has been paid. Otherwise I will return the books postpaid.

Name .....

Address .....

City and State .....

Company .....

Position ..... W. 5-11-46

For Canadian prices write Embassy Book Co., 12 Richmond St. E., Toronto 1

SALT TABLETS and DISPENSERS

Maintained close to the drinking water supply they provide a convenient and sanitary means of supplying your workers with Salt Tablets during the hot Summer months.

Replaces the salt lost thru perspiration, prevents heat sickness and sustains normal energy. Time proven and recognized by all industries.

PRACTICAL FOR INDOOR and OUTDOOR USE

Furnished complete with mounting bracket for wall installation, on tool trucks, trailers and other locations.

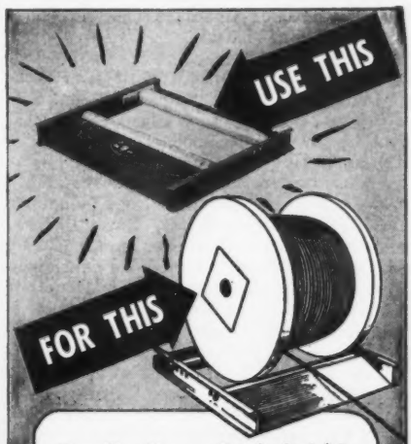
WRITE FOR BULLETIN EW-56

IPCO

Safety Equipment for all Industries

INDUSTRIAL PRODUCTS COMPANY

2808 N. FOURTH STREET • PHILADELPHIA 33, PA.



Handles Heavy Reels Quickly . . . Safely . . . Economically

Saves time and money in the plant, warehouse or on the job.

Roll-A-Reel is the ideal way to reel or unreel wire, cable, or rope and does an easier, better job in every way.

In two sizes . . . 2000 lbs. capacity—$37.50 and 4000 lbs. capacity — $75.00 F.O.B. Cincinnati.

Send for descriptive pamphlet.

ROLL-A-REEL

327 WEST FOURTH STREET

CINCINNATI 2, OHIO

specialties. Machinery and electrical equipment will be installed to provide advance of about 40,000 tons per month. Project will include expansion in power plant, transformer stations and other electrical facilities, and is estimated to cost approximately $12,000,000. Program will require 12 to 18 months for completion.

TENNESSEE—City Council, Clarksville, has plans under way for extensions and improvements in street-lighting system in downtown district, including number of new units. Cost reported close to $100,000. J. T. Cunningham is city engineer, in charge.

MONTANA—Bureau of Reclamation, Denver, Colo., will receive bids until May 24 for one 10-ton, motor-operated traveling crane for installation in warehouse at government camp at Hungry Horse dam, Hungry Horse project, Mont.; also, for one 10-ton similar motor-operated crane for government camp at Boysen dam, Boysen unit, Wyo., Missouri Basin project; and for one 15-ton, motor-operated traveling crane for warehouse at government camp at Davis dam, Davis Dam project, Ariz. Cranes will be installed by government (Specifications 1305).

WASHINGTON—Weyerhaeuser Timber Co., Longview, has made application to CPA, federal agency, for authority to proceed with construction of proposed new sulphate pulp mill, comprising several large multi-story buildings, with machinery and electrical equipment for annual rating of about 70,000 tons. Also for improvements and changes in existing pulp mill for conversion from lime base to magnesium base process. Entire project will require more than 12 months for completion and is reported to cost close to $7,000,000. Otto C. Schoenwerk, 3240 North Lake Shore Dr., Chicago, Ill., is consulting engineer.

TEXAS—Water, Light and Power Department, Municipal Bldg., Austin, plans expansion and improvements in municipal steam-electric generation station, with installation of additional equipment. Also will make extensions and betterments in electrical distribution system. Cost estimated about $770,000. Proposed to arrange bond issue.

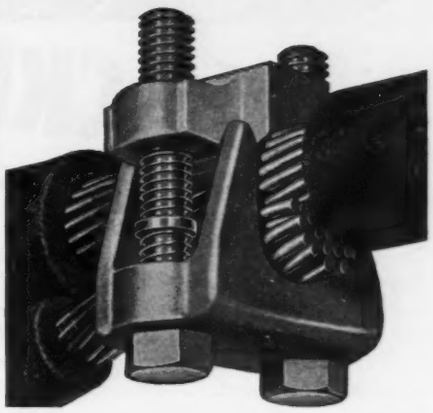
SOUTH CAROLINA—Greenwood County Electric Power Commission, Greenwood, will have plans prepared by George Hill, Wellford, consulting engineer, for proposed new steam-electric generating station, recently projected, to supplement present power supply from Buzzard Roost hydroelectric power and auxiliary steam station. Cost estimated about $1,000,000, with switchyard and connecting transmission lines.

CALIFORNIA—Bureau of Reclamation, Denver, Colo., will receive bids until May 30 for one operating unit with control equipment for 72 by 93-in. horizontal jet pump for fish trap, Keswick dam, Central Valley project, Calif. Equipment will be installed by government (Specifications 1317).

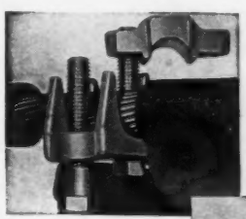
OHIO—Department of Public Service, Troy, John F. Porter, director, plans early call for bids for new municipal steam-electric generating plant to replace present station. Cost estimated about $2,300,000. William C. Kammerer & Associates, 1900 Euclid Ave., Cleveland, are consulting engineers.

NEBRASKA—Consumers Public Power District, Columbus, plans early construction of new transmission lines from Central City to Fullerton, Humphrey and vicinity, totaling about 35 miles, in all.

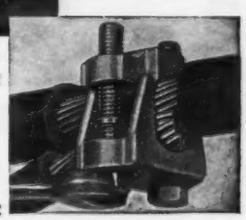
MATTHEWS UNICLAMP CONNECTORS



Made for use on copper or aluminum wires from 2/0 to 1000 MCM inclusive. They will connect two wires of their rated size or one wire of their rated size with one or more smaller tap-off wires down to No. 8 solid. They have many advantages over the larger sizes of connectors of the split bolt and other designs as they provide greater pressure between wires, hence greater holding power, are less costly, are easier to install and the assembled design is such that parts cannot become separated.



Fit on conductor as shown. Position top member and partially thread in free bolt.



Insert tap wire and equally draw up both bolts.

Write for Bulletin 206

W. N. MATTHEWS CORP.

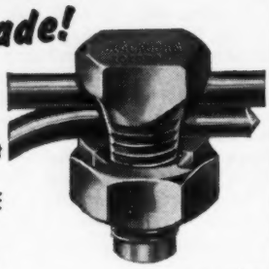
3722 FOREST PARK BLVD.

ST. LOUIS 8, MO.

WITH THE MEN WHO KNOW

It's BLACKBURN

The Most DURABLE Connector Made!



They're first choice of men who know—Engineers, Buyers, Jobbers, because they've proved to be the most durable connector made. That's because they're the only complete line of connectors made of DURONZE — the alloy that's 75% stronger than hard copper or commercial bronze. Hence, BLACKBURN Hi-Strength Connectors will not distort, are trouble-free on the line, and may be used over and over. They cut maintenance costs! *It pays to use a QUALITY Product!*

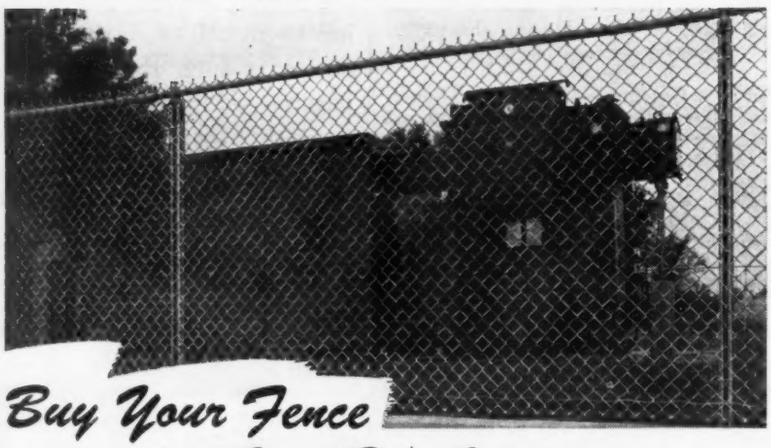
Over 100 Conveniently-Located Jobbers' Stocks

BLACKBURN Hi-Strength CONNECTORS

Jasper Blackburn
PRODUCTS CORP.
First, Madison & Clinton Sts.
ST. LOUIS 6, MO.

PAGE FENCE - Since 1883

• AMERICA'S FIRST WIRE FENCE •



Buy Your Fence as You Buy Insurance

• When you choose protection for your property, buy the fence that is best suited to your individual needs. You can have a long-lasting Page Chain Link Fence in a choice of four superior metals, one of which will be best for you: 1. Corrosion-resisting Page Aluminum. 2. Page Copper-Bearing Steel, heavily galvanized. 3. Page-Allegheny Stainless Steel, immune to rust. 4. Page-Armco Ingot Iron, purest commercial ferrous metal. And you can have your fence erected by a nearby fence engineering firm which is long-experienced and reliable. Write to any office listed below for illustrated information.

For name of nearest member firm, write to PAGE FENCE ASSOCIATION in Monessen, Pa., Atlanta, Bridgeport, Chicago, Denver, Detroit, Los Angeles, Philadelphia, Pittsburgh, New York or San Francisco

PRODUCT OF PAGE STEEL & WIRE DIVISION OF AMERICAN CHAIN & CABLE • BRIDGEPORT, CONN.

REA Allots $13,779,550 for Rural Projects

The Rural Electrification Administration has recently approved allotments totaling $13,787,550 to 46 co-ops.

Nine of these loans, totaling $3,694,500, were to make possible area coverage rural electrification through purchase and rehabilitation of the facilities of the Eastern Minnesota Power Corp. and construction of new lines around the nucleus of the acquired system. A reorganization plan involving the Eastern Minnesota Power Corp., which is a subsidiary of the Manufacturers Trust Co. of New York City, is now on file with SEC. The approvals in connection with this purchase are as follows:

MINNESOTA—P.I.C.K. Cooperative Electric Assn., Braham, $1,737,000; Rural Cooperative Power Assn., Maple Lake, $1,151,500; North Pine Electric Cooperative, Inc., Finlayson, $215,000; Anoka County Light & Power Assn., Anoka, $202,000; Mille Lacs Region Cooperative Power & Light Assn., Aitkin, $150,000; Minnesota Valley Electric Cooperative, Jordan, $115,000; McLeod Cooperative Power Assn., Glencoe, $55,000; Blue Earth-Nicollet Cooperative Electric Assn., Mankato, $52,000; Brown County Electrical Assn., Sleepy Eye, $17,000.

The other allotments, which will be used to provide electric service to farms and other rural establishments, include the following:

ALABAMA—Pea River Electric Cooperative, Clayton, $400,000; Cherokee Electric Cooperative, Centre, $350,000.

ARKANSAS—Carroll Electric Cooperative Corp., Berryville, $620,000; Petit Jean Electric Cooperative Corp., Clinton, $230,000.

GEORGIA—Irwin County Electric Membership Corp., Ocilla, $465,000.

INDIANA—Dubois Rural Electric Cooperative, Inc., Jasper, $65,000; Whitely County Rural Electric Membership Corp., Columbia City, $65,000; Jasper County Rural Electric Membership Corp., Rensselaer, $40,000.

MINNESOTA—Fidelity Gas Co., a subsidiary of Montana-Dakota Utilities Co. of Minneapolis, $612,500, to make low-cost public power available to 18 REA-financed distribution co-ops (13 in North Dakota, 3 in South Dakota, and 2 in Montana). This loan is to be used exclusively for construction of transmission facilities. Wild Rice Electric Cooperative, Inc., Mahnemen, $360,000; Stearns Cooperative Electric Assn., Melrose, $325,000; Nobles Cooperative Electric Co., Worthington, $315,000.

MISSISSIPPI—Pearl River Valley Electric Power Assn., Columbia, $596,000; Magnolia Electric Power Assn., McComb, $510,000.

MISSOURI—Barton County Electric Cooperative, Lamar, $79,000.

MONTANA—Valley County Electric Cooperative, Inc., Glasgow, $275,000.

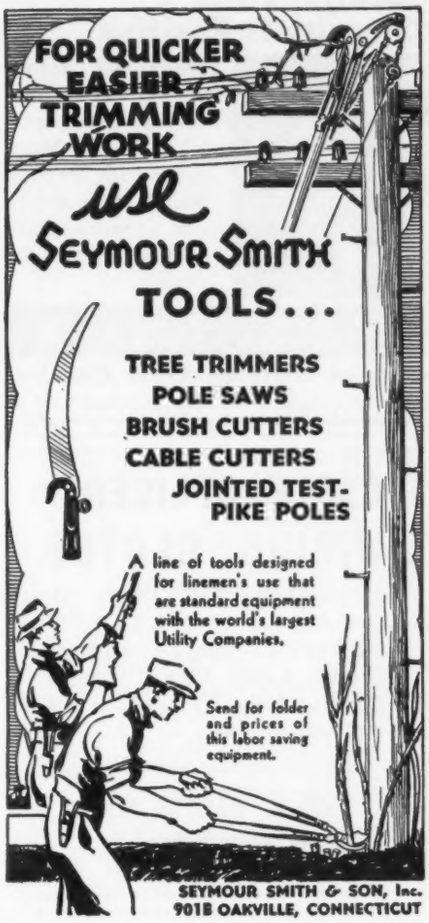
NEBRASKA—Loup Valley Rural Electric Membership Assn., Ord, $389,000; Southern Nebraska Rural Public Power District, Grand Island, $360,000; Norris Rural Public Power District, Lincoln, $325,000.

NORTH CAROLINA—Central Electric Membership Corp., Sanford, $50,000.

NORTH DAKOTA—Tri-County Electric Cooperative, Inc., Carrington, $660,000.

OHIO—Morrow Rural Electric Cooperative, Inc., Mount Gilead, $50,000.

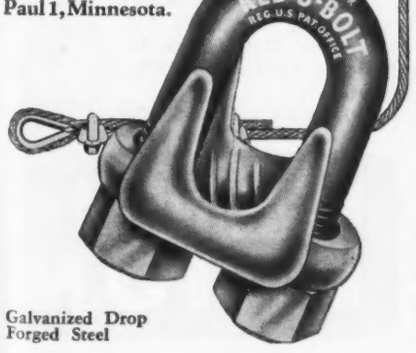
OKLAHOMA—East Central Oklahoma Electric Cooperative, Inc., Okmulgee, $352,000;


FOR QUICKER EASIER TRIMMING WORK
use SEYMOUR SMITH TOOLS...
TREE TRIMMERS
POLE SAWS
BRUSH CUTTERS
CABLE CUTTERS
JOINTED TEST-PIKE POLES
A line of tools designed for linemen's use that are standard equipment with the world's largest Utility Companies.
Send for folder and prices of this labor saving equipment.
SEYMOUR SMITH & SON, Inc.
901B OAKVILLE, CONNECTICUT

Because they're *safer*, always use

CROSBY CLIPS

Specify Crosby Clips—it's your best choice, and they're available through dealers everywhere. A product of the American Hoist & Derrick Company, St. Paul 1, Minnesota.



Galvanized Drop Forged Steel

Cotton Electric Cooperative, Walters, $290,000.

South Carolina—Little River Electric Cooperative, Inc., Abbeville, $206,550; Black River Electric Cooperative, Inc., Sumter, $177,000.

South Dakota—McCook Electric Assn., Inc., Salem, $300,000.

Tennessee—Caney Fork Electric Cooperative, Inc., McMinnville, $250,000.

Texas—South Plains Electric Cooperative, Inc., Lubbock, $293,000; Dewitt County Electric Cooperative, Inc., Cuero, $240,000; Concho Valley Electric Cooperative, Inc., San Angelo, $160,000; Guadalupe Valley Electric Cooperative, Inc., Cost, $25,000.

Virginia — BARC Electric Cooperative, Millboro, $250,000.

Wisconsin—Chippewa Valley Electric Cooperative, Cornell, $150,000; Polk-Burnett Electric Cooperative, Centuria, $105,000; Crawford Electric Cooperative, Gays Mills, $67,000.

Wyoming—Riverton Valley Electric Assn., Inc., Riverton, $86,000.

•

Recent Rate Changes

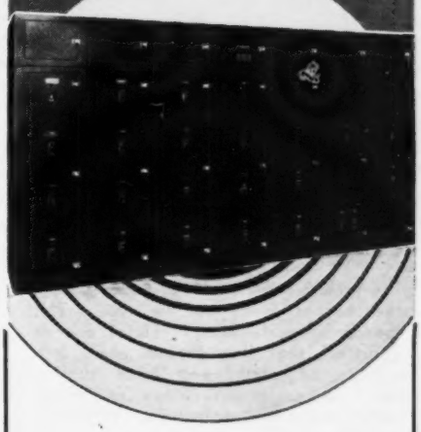
Potomac Edison Co. has been ordered by the Maryland Public Service Commission to reduce its electric rates $394,000 annually to its Maryland customers. Annual savings to all of the company's customers, including a $121,000 reduction in charges made for energy supplied to affiliated distributing companies which provide service outside the state, were estimated at $515,000. The reduced charges under revised schedules of rates will be applied to all consumption billed after May 1.

Oklahoma Gas & Electric Co. has added new power rate cuts to the reduction announced in March, trimming $767,968 from the bills of its customers. Residents of 200 cities are affected. Reductions will become effective on bills rendered after July 1, 1946. Of the total reductions, $567,444 will be shared by residential, commercial and rural customers. The remainder, approximately $200,000, announced last month, applies to municipalities for street lighting, water pumping, and public buildings. The new cuts will mean savings of $110,888 annually to residential customers in Oklahoma City and $43,949 to commercial users, George A. Davis, Oklahoma Gas & Electric president, said. Under this plan, the new residential rate will be 18 kw.-hr. for $1; the next 22 kw.-hr. at 3½ cents each; and the next 100 kw.-hr. at 3 cents, with all additional energy used at 2 cents per kilowatt-hour.

Arizona Power Co. has been ordered by the State Corporation Commission to make an 8 percent reduction on wholesale power rates assessed the Smelter City Improvement Association. The rate reduction for the association, a Verde Valley cooperative, followed a recent hearing held by Yale McFate, commission member. Acting upon Mr. McFate's findings, the commission found the wholesale power rates "were in fact excessive." The new lower schedule was ordered placed in effect "pending further investigation and study of rate structures of the Arizona Power Co."

Kentucky & West Virginia Power Co.'s rate reduction of $355,000 a year has been approved by the state Public Service Commission. The commission last December directed all utilities to show cause why they should not reduce their rates in view of being relieved of the excess profits tax burden. Kentucky & West Virginia offered to

Would you be interested—in a *Better Source of Supply* for SWITCHBOARDS?



ENGINEERING SERVICE THAT'S UNUSUALLY HELPFUL. No matter how difficult your problems of design, our engineers have probably solved them . . . exceptional experience in planning every kind of switchboard and special panelboard. We take full responsibility for meeting all applicable specifications and requirements.

HIGHEST QUALITY, EXCLUSIVELY. The best of materials and skilled workmanship, backed by rigid engineering inspection. Every Pelham switchboard or panelboard is guaranteed to give completely satisfactory service.

DEPENDABLE DELIVERIES. Special switchboards are designed and built with unusual promptness. Our deliveries are made when promised.

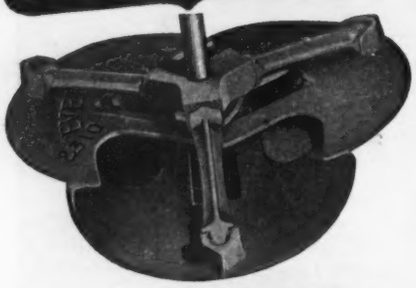
Call your Pelham representative, or write or wire the factory.

PELHAM ELECTRIC MFG. CORP.
Erie, Pa.

SPECIALIZED DESIGN
Pelham
UNEXCELLED QUALITY

SWITCHBOARDS • PANEL BOARDS
SWITCH GEAR AND ACCESSORIES

EVERSTICK ANCHORS...



FOR SPEED IN INSTALLATION

The exclusive Everstick nut housing locks the Anchor firmly on the rod. This speeds up installation. Plates are so designed, that they expand easily into undisturbed earth, and extra holding power is achieved. Made of tough, rust-resistant malleable iron. Write for bulletin.

EVERSTICK ANCHOR CO.
FAIRFIELD, IOWA

Fill out and mail for 48-page illustrated catalog.

NAME_____

Firm Name_____

Address_____

ILSCO COPPER TUBE & PRODUCTS, Inc. CINCINNATI, OHIO

lower its charges to large users $213,000 a year, which the commission accepted, then followed with an additional cut of $142,000 for residential and commercial customers, making the $335,000 total approved. Kentucky & West Virginia's first reduction became effective for large users on January 1. The additional cut of $142,000 for residential and commercial customers became effective May 1.

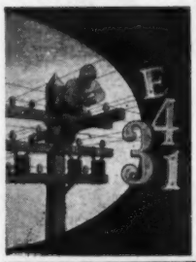
SOUTHERN CALIFORNIA EDISON CO., LTD., has been ordered by the State Railroad Commission to make a reduction in its electric power rates aggregating about $1,725,000 for the year. The recent $1,500,000 rate reduction decision was preceded by a recently authorized slash of $225,000 in power rates. Beginning June 1, the new schedule will become effective for Edison's Los Angeles county residential and commercial customers who will save approximately $1,000,000 through the change. A later September 1 reduction will affect these same classes of service, together with other consumers. L. Harold Anderson, president of the railroad commission, announced that engineers are currently engaged in determining basic rate spreads for the new rates.

SOUTH PENN POWER CO., Hagerstown, Md., new rate schedule, reducing rates to 10,000 consumers approximately $91,000 a year, has been approved by the Pennsylvania Public Utility Commission. South Penn Power serves consumers in portions of Adams, Bedford, Franklin and Fulton counties in Pennsylvania. All classes of consumers are to receive reductions. Residential consumers will be saved $32,705; commercial, $19,716; industrial, $36,175; street lighting, $1,286; miscellaneous, $1,637. Basic monthly minimum charges in Waynesboro will be decreased from 95 to 75 cents and in rural districts, $1.50 to $1. Guaranteed monthly payment by customers served under the present rural extension plan will be decreased from $12 to $6 per mile of extension.

EDMONTON ELECTRIC LIGHT AND POWER DEPT., Edmonton, Alberta, Canada, has reduced its electric light rates $286,000 to consumers in the first twelve months, effective May 1. Under the new rate structure, the present domestic rate, five cents for each of the first 300 kw.-hr.; four cents for each of the next 300; and three cents for all over 600, and the combination rate of five cents for each of the first 30 kw.-hr.; two cents for each of the next 120, and 1½ cents for all over 150, will be combined. The new rate will be four cents for each of the first 40 kw.-hr.; two cents for the next 110 and 1½ cents for all over 150, with a minimum charge of $1. The minimum charge on the present domestic rate is $1 while the minimum on the combination rate is $2.50. Under the new schedule persons using electric ranges of 40 kw. or over will pay four cents for each of the next 110 kw.-hr., and one cent for each over 150. The minimum charge will be $1. Under the old rate, they had a minimum of $2.50 and paid five cents for each of the first 30 kw.-hr., two cents for each of the next 120 kw.-hr., and one cent for all over 150. The new commercial rate calls for four cents on each of the first 100 kw.-hr., 3½ cents on each of the next 500 and two cents on all 600. The former rate was five cents for each of the first 300 kw.-hr., four cents for each of the next 300, and three cents for all over 600.

NEW JERSEY POWER & LIGHT CO. has asked the State Board of Public Utility Commissioners for permission to reduce annual charges to its customers by $453,000 under the board's rate adjustment plan. The company has proposed both lower rates and a rebate this year.

Identification Of Circuits Is Positive



Don't let repair crews waste time trying to locate circuits. Mark them with Premax Metal Characters and avoid costly errors. Send for details.

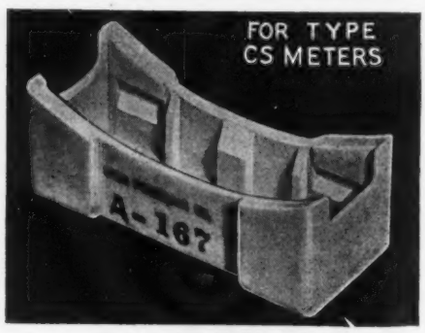
Premax Products
Division Chisholm-Ryder Co., Inc.
4606 Highland Ave., Niagara Falls, N. Y.

CABLE-SPLICERS' WIPING CLOTHS

IMPROVED PATTERNS OF GREATER UTILITY
Formed-flexible Finishing Cloths. Catch Cloths. Crotch Cloths. New Type Cloth for Vertical Joints.

Send for literature and prices.

GEO. E. WILLIAMS, Mfr.
3035 Aldrich Ave. So.
Minneapolis, 8, Minn.



STAR METER SEAL
Eliminates meter tampering. Cannot be removed without mutilating. SEND FOR SAMPLE.
STAR PORCELAIN CO.
51 Muirhead Ave. Trenton, N. J.
STAR PORCELAIN COMPANY, Ltd.
49 MAIN ST. TORONTO 14, ONT.

Conductor Fittings

Tees, Service Connectors, Lugs, Grounding Clamps, Straight and Parallel Connectors, Elbows, Cable Taps, etc., etc.

PENN-UNION ELECTRIC CORP.
ERIE, PA.

PENN-UNION

Recent Legislation

Measures, affecting the public utility industry, recently signed by Governor Dewey of New York, include the following:

A bill asserting the state's right to control reorganization of public utility holding companies if consumer services are affected. According to legal sources, the measure admits that "state law will not control the acts of Federal courts in reorganizing utility holding corporations," a procedure established by the Public Utility Holding Company Act of 1935. However, these sources say that any change in public service resulting from such a reorganization plan must be approved by the Public Service Commission.

The Stephens Bill as Chapter 932, of the laws of 1946, to amend the Conservation Law. The law will provide that consent may be given to public utilities to pass over, through or under state park properties, authorizing licenses and easement for public purposes, in relation to division of parks.

The Marble Bill as Chapter 879, laws of 1946, amending ¶346 Highway Law, to provide telephone and telegraph wires, power transmission and gas, oil and water lines, conduits and cable that cross state thruway may in discretion of public works superintendent be relocated in suitable facilities to be installed under, over and across thruway, cost to be charged to thruway; such relocation may be done by owners.

•

Lear Gives Wage Increase

Lear, Inc., Grand Rapids, Mich., has announced a general wage increase of 16½ cents per hour through its president, William P. Lear. "We are fully aware of rising living costs," said Mr. Lear, "and realize the necessity of doing what we can to help our employees meet these higher costs." Mr. Lear further pointed out that the company is now accelerating its production program for home radios, aircraft radios, wire and tape recorders, and its complete line of electromechanical units.

•

Enters Electric Hoist Field

Wright File Co., Lisbon, Ohio, has expanded its activities, the outcome being the Lisbon Hoist & Crane Co. located in its modern large plant. This expansion followed the war-time experience of the company, which for lack of being able to obtain a satisfactory electric hoist to handle the heavy parts being manufactured for the Ordnance Division of the U. S. Government, designed and built an electric hoist suitable for such purposes.

•

Buys New Laboratory Site

American Society of Heating and Ventilating Engineers has purchased a three-story dwelling and attached two-story auditorium-type building in Cleveland, Ohio, for use as a research laboratory.

This Extra Deep Socket Insures Greater Mechanical Strength plus Higher Conductivity

Extra strength, to withstand any stresses — plus extra capacity to insure minimum IR drop! That's the combination that has made these Sherman Soldering Lugs the standard of the electrical industry.

Sherman Lugs are bright and clean, too, with no sharp edges or burrs — and the contact surfaces are FLAT.

Write for catalog which gives full specifications on a wide range of sizes and styles.

H. B. SHERMAN MFG. CO.
BATTLE CREEK, MICHIGAN

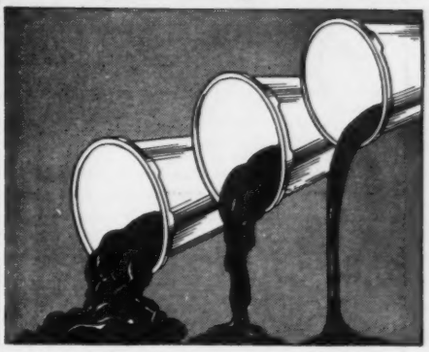
Sherman HEAVY DUTY SOLDERING LUGS

ALL the strength and durability inherent in steel are combined—with definite economies—in Crapo Galvanized Steel Strand. Heavy, ductile, tightly-bonded zinc coatings, applied by the famous Crapo Galvanizing Process, provide lasting protection against corrosion.

Ask the distributor of Crapo Galvanized Products near you or write direct for further information!

INDIANA STEEL & WIRE CO.
MUNCIE, INDIANA

Insulating and Cable-Pulling
COMPOUNDS
of Record-Breaking Performance



Minerallac gives you a complete assortment for every need: dense, viscous and fluid consistencies for high and low voltages in cable-joints, pot-heads, terminal bills, distribution cables, street lighting, telephone work. . . . Insoluble in oil or water, for all temperatures. Clean, safe, economical—outranks all others in quality.

Send for new literature and prices.

MINERALLAC ELECTRIC COMPANY
25 North Peoria Street—Chicago 7, Illinois

MINERALLAC

PROFESSIONAL SERVICES

Associated Engineers, Inc.

Joseph C. Lewis, President

Management Consultants
Engineering . . Architecture - - Accounting
Organization - - Methods - - Costs.

230 E. Berry St., Fort Wayne 2, Ind.

BARKER & WHEELER

Utility and Industrial Valuations, Design and Construction of Power Systems, Water Supplies, Sewerage and Sewage Disposal, Factory Production and Cost Control Systems.

11 Park Place, New York City
36 State Street, Albany, N. Y.

BLACK & VEATCH

Consulting Engineers

Water, Steam and Electric Power, Investigations, Design, Supervision of Construction, Valuation, Tests and Laboratory Service.

4706 Broadway, Kansas City, Mo.

E. J. CHENEY AND CO.

ENGINEERS AND CONSULTANTS

Economic and Business Surveys
Valuations and Reports
Rate and Rate Case Analyses

61 Broadway New York

HUGH L. COOPER & CO. INC.

General Hydraulic Engineering, including the design, financing, construction and management of hydro-electric power plants.

350 Fifth Avenue New York 1, N. Y.

DAY & ZIMMERMANN, Inc.

ENGINEERS

Design - Construction - Management
Investigations and Reports

NEW YORK PHILADELPHIA Packard Building CHICAGO

DOBLE ENGINEERING COMPANY

Electrical Insulation Engineers

Field Testing and Maintenance of High Tension Insulation, Special Problems in Electrical Communications.

Office and Laboratory: Medford Hillside, Boston, Mass.

Branch Office: 20 N. Wacker Dr. Chicago, Ill.

Ebasco Services Incorporated

Design and Construction
Financial and Operating Consultation
Investigations and Reports
Consulting Engineering

Two Rector Street New York

ELECTRICAL TESTING LABORATORIES INC.

Specializing in

TECHNICAL SERVICES
to those intent upon good quality

2 East End Avenue at 79th St., New York 21, N.Y.

H. F. FERGUSON

Consulting Electrical Engineer

Expert advice on location and purchase of right of way.
Industrial plant layouts & surveys. Rate comparisons.

288 Alameda Avenue Youngstown, Ohio

ROBERT E. FOLEY CONSTRUCTION CORPORATION

Rural Lines—Transmission Lines
Fire Alarms—Telephone Lines

48 Griswold St. Binghamton, N. Y.

FORD, BACON & DAVIS

ENGINEERS

DESIGN • CONSTRUCTION
VALUATIONS • REPORTS

New York • Philadelphia • Chicago • Los Angeles

FRANK F. FOWLE & CO.

Electrical and Mechanical
ENGINEERS

35 East Wacker Drive Chicago, Ill.

PAUL E. GERST & CO.

CONSULTING ENGINEERS

Specialists in
Electrical Product Design
El. Machinery, Apparatus & Applications
El. Appliances, Hi-Frequency Apparatus
Electronics, Radio Communications.

205 W. Wacker Dr. Chicago 6, Ill.

GILBERT ASSOCIATES, Inc.

Engineers and Consultants

DESIGN, CONSTRUCT, OPERATE & MAINTAIN INDUSTRIALS AND PUBLIC UTILITIES
Reports • Rates • Labor relations • Safety • Purchasing • Costs • Laboratory

61 Broadway New York — Reading Pa. — 17 & Sansom Phila., Pa.
1417 K St. N.W. Washington, D. C.

FREDERIC R. HARRIS, INC.

ENGINEERS CONSTRUCTORS

MANAGEMENT
NEW YORK

Knoxville Houston San Francisco

HENKELS & McCOY

(Electric & Telephone Line Construction Co.)

Wood pole transmission lines
Electric Distribution and maintenance

Philadelphia, Pa.

HOOSIER ENGINEERING COMPANY

Erecting Engineers
Transmission Lines, Substations

46 So. 5th St., Columbus, Ohio
327 South LaSalle Street, Chicago, Ill.
136 Liberty St., New York

WILLIAM S. LEFFLER

succeeding
CHARLES F. LACOMBE—WILLIAM S. LEFFLER
Engineers—Economists
RATE RESEARCH — SALES RESEARCH
FOR
POST-WAR PLANNING
Cost Analysis Rate Cases
Noroton, Connecticut

LUCAS & LUICK

ENGINEERS

DESIGN, CONSTRUCTION SUPERVISION, OPERATION, MANAGEMENT, APPRAISALS, INVESTIGATIONS, REPORTS, RATES

231 S. LaSalle St., Chicago

CHAS. T. MAIN, INC.

Engineers

Boston, Mass.

Electric, Steam and Hydraulic Projects. Investigations, Reports, Designs and Appraisals.

J. H. MANNING & COMPANY

ENGINEERING
SERVICES

120 Broadway, New York

DANIEL W. MEAD F. W. SCHEIDENHELM

Consulting Engineers

Hydro-Electric Development, Dams, Water Supply, Flood Control, Engineering Problems relating to Water Rights and Water Power Law. Appraisals.

New York City, 50 Church St.

ARTHUR L. MULLERGREN

Engineering-Management

Public Utilities—Natural Gas

Kansas City, Mo.

PUBLIC UTILITY ENGINEERING & SERVICE CORPORATION

Consulting Engineers

Design Operations

Steam—Hydraulic—Gas

231 S. La Salle St. Chicago 4, Ill.

Recording & Statistical Corp.

BILL ANALYSIS—CONSUMPTION STUDIES
THE ONE-STEP METHOD
Bill Frequency Analyzer

102 Maiden Lane New York

SANDERSON & PORTER

ENGINEERS

AND

CONSTRUCTORS

SARGENT & LUNDY

ENGINEERS

140 South Dearborn St.

Chicago, Ill.

THE J. G. WHITE ENGINEERING CORPORATION

Design • Construction • Reports • Appraisals

80 Broad Street, New York 4

WHITMAN, REQUARDT AND ASSOCIATES

ENGINEERS — CONSULTANTS

Power Plants — Industrial Plants
Steam and Electric Distribution Systems
Waterworks and Sewerage
Reports—Plans—Supervision—Appraisals

1304 St. Paul Street Baltimore 2, Md.